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ABSTRACT

This teacher/counselor guide presents a science career development program especially designed for students with deafness in residential schools, day schools, or mainstream settings. The program consists of three sections: "Why Consider a Career in Science?"; "What Do People in Science Do?"; and "How Do You Find Out If Science Is a Career for You?" The learning activities are designed as teacher-led discussions to be used with small groups, where much of the direction for the activity can be based on students' individual experiences. For each activity, the purpose is stated, materials needed are listed, background information is provided, guidance is given for conducting the activity, optional activities are noted, and teacher and student references are listed. A chart describes each learning activity and lists science careers and scientists mentioned within that activity. Another chart provides a suggested activity sequence based on the amount of time available for teaching the unit. A list of professional societies with career information is included. (JDD)

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Teacher/Counselor Guide To

IS SCIENCE A POSSIBLE CAREER FOR YOU?

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A Science Career Development Program Especially Designed for Deaf Students

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Teacher/Counselor Guide To

IS SCIENCE A POSSIBLE CAREER FOR YOU?

A Science Career Development Program
Especially Designed for Deaf Students

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July, 1978.

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Introduction

"Is Science a Possible Career for You?" is a science career development program especially designed for deaf students. It was funded by a grant from the Physically Handicapped in Science Program, Division of Scientific Personnel Improvement of the National Science Foundation.

Handicapped students face several barriers when they consider science careers: the lack of role models, little science content in their schooling, discrimination, and negative personal aspirations. Deaf students face all these problems, yet suffer the additional burden of a communication barrier.

This program responds to these conditions. Designed to meet the unique needs of deaf students in language, science education, and science career development, it fills a void in the career development resources now available for deaf students. These materials are sensitive to the syntax, vocabulary development, and experiences common to many deaf students. Their special needs in projective and imaginative thinking and in inquiry skills are also considered. Throughout the program, students are encouraged in many ways to study and learn more about science: there are role models,[1] visits to places where scientists work, a look at what science-related jobs are available, an awareness of what science preparation beyond high school is now accessible, and a realization that science does offer career opportunities[2] for handicapped people, women, and/or minorities.

The materials are designed for thirteen- to sixteen-year olds in a residential school, day school, or mainstream setting where students use oral, finger spelling and speech, or total communication techniques. Since the lessons are supplementary in nature, they can easily be infused into an existing course and/or program (e.g., a career development program, science course, or social studies program). The materials are versatile: they could be used as the basis of a one-day career workshop with follow-up activities; they could be used on successive days; or they might be integrated into the present curriculum.

The materials were first tested with a group of fifty students at a residential school for the deaf, then field-tested at nine sites representing each of the main communication techniques (oral, finger spelling and speech, and total communication), and each of the major instructional settings (residential, day, and mainstream).

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[1] References to deaf scientists in this program are meant to show students that if they select a science career, they will not be the first deaf people to enter science as a career. Nineteenth century deaf scientists are discussed to emphasize that there is nothing new about a deaf person accepting the challenge of a science career. Providing these examples does mean more men than women are included. This places a burden on you to describe the emerging role of women in all areas of employment, including science.

[2] This career development program will discuss the complete range of careers in science. The word "scientist" is used infrequently to emphasize the broad range of careers in science and to show that one need not be a "scientist" to have a career in science.

Is Science a Possible Career for You?
ACTIVITY OUTLINE

ACTIVITY NUMBER	DESCRIPTION	SCIENCE CAREERS	SCIENTISTS
WHY CONSIDER A CAREER IN SCIENCE?			
A-1 Science Offers Career Opportunities for Deaf Students	Filmstrip providing role models of deaf individuals in science-related careers. Optional 1: Reading "Biographies of the Filmstrip Scientists." Optional 2: Reading "Some Thoughts from the Filmstrip Scientists."	CHEMIST BIOCHEMIST MICROANALYTICAL CHEMIST SYSTEMS ANALYST METEROLOGIST PROGRAMMER	JAY BASCH* NANSIE SHARPLESS* WILLIAM PICKHARDT* DARCY SLAPPEY* CHARLES VLCEK* HERSHELLA HEARNS*
A-2 I Have Interests in Science	Values clarification activity focusing on student interests: Part 1, list "things I love to do;" Part 2, sentence stems. (Handout) Optional: Evaluation of science career.	MICROBIOLOGIST	JAMES LOGAN*
A-3 I Have Assets and Abilities Suitable for a Science Career	Values clarification activity focusing on student assets and abilities: Part 1, fantasy; Part 2, drawings of "what I do well and what I want to do better." Optional: Exploration of attitudes toward women in science-related careers.	MEDICAL TECHNOLOGIST	JEAN KELSCH CORDANO* List of notable women scientists
A-4 A Science Career May Meet My Needs	Values clarification activity focusing on student needs: Part 1, "needs" collage; Part 2, values voting. (Transparency)		
A-5 Science Is a Growth Industry	Values clarification activity focusing on student attitudes towards science, scientists, and science careers: Part 1, continuum; Part 2, rank ordering. Optional: Exploration of attitudes regarding availability of science jobs.	SYSTEMS ANALYST MATHEMATICIAN SYSTEMS PROGRAMMER PROGRAMMER	PHILIP A BRAVIN* SELINA GILSON* JOSEPH S. SLOTNICK* DONALD H. STOOPS*
A-6 Scientific Work Is Important	Discussion of the impact of science in our lives. (Handout showing a kitchen in 1900 and now) Optional: Drawing "inventions."		
A-7 The Results of Scientific Work Change Our Lives: One Example	Exploration of automobile technology as an example of the way people in science and engineering have changed our lives. (Transparency) Optional: Brainstorming improvements for common products.	AUTOMOTIVE TECHNICIAN	GEORGE T. DOUGHERTY*
WHAT DO PEOPLE IN SCIENCE DO?			
B-1 People in Science Work on Many Topics	Exploration of the various areas (disciplines) of science. (Transparency outlining various science occupations) Optional 1: Exploration of six science careers. (Transparency) Optional 2: Discussion of science careers from magazine pictures. Optional 3: Dramatization of a science career. Optional 4: Student presentation following research of a science career.	Outline of science occupations AGRONOMIST CIVIL ENGINEER HERPETOLOGIST ELECTRICAL TECHNICIAN DEMOGRAPHER ASTRONOMER List of career guidance publications	
B-2 People in Science Have Various Responsibilities	Exploration of the various responsibilities individuals can have in science careers and the opportunities for a technical career in science. (Transparency outlining technical and semiprofessional science occupations) Optional: Exploration of "basic" and "applied" science. (Handout)	Checklist of Technical/Semiprofessional Science Occupations	MARIE CURIE PIERRE CURIE LOUIS PASTEUR JOSEPH LISTER ASCANIO SOBRERO ALFRED BERNHARD NOBEL CHARLES TOWNES THODORE MAIMAN BARDEEN/BRATTAIN/SHOCKLEY CHARLES RICHARD DREW THOMAS A. EDISON* JOHN AMBROSE FLEMING JOHN GORRIE SAMUEL F.B. MORSE MARY PENNINGTON FLORENCE RENA SABIN MARIA TELKES J.H. WEGSTEIN ROBERT H. WEITBRECHT*

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B-3 **People** in Science Observe the Natural World	Exploration of the use of one's senses in science-related work. (Transparency) Optional: Discussion of eight science jobs. (Transparency)	PALEONTOLOGIST MICROBIOLOGIST BOTANIST ZOOLOGIST ASTRONOMER GEOGRAPHER (GLACIOLOGIST) STATISTICIAN ORNITHOLOGIST	
B-4 **People** in Science Share Their Findings	Exploration of communication among those in science with an opportunity for students to communicate about imaginary scientific "discoveries." (Discovery Cards)	ALEXANDER GRAHAM BELL	
B-5 People in Science Often Work as a Team	Exploration of the diversity of tasks/jobs within one area of science and the teamwork among those in a science career. (Transparency) Optional 1: Exploration of ten jobs in archaeology. (Transparency) Optional 2: Discussion of the team work required to get a person on the moon.	GEOLOGIST SURVEYOR PALEOANTHROPOLOGIST PETROLOGIST PEDOLOGIST PALYNOLOGIST PALEONTOLOGIST GEOCHEMIST PREPARATOR PHYSICAL ANTHROPOLOGIST SYSTEMS ENGINEER (AEROSPACE)	PAUL L. TAYLOR*
B-6 Many People in Science Are Communitted to Their Work	Discussion of George Washington Carver's quote "Anything will give up its secret if you love it enough." Optional 1: Research of "secrets" scientists are presently studying. Optional 2: Reading about black scientists.	AGRICULTURAL RESEARCHER PALEOBOTANIST	GEORGE WASHINGTON CARVER LEO LESQUEREUX* List of notable black scientists
HOW DO YOU FIND OUT IF SCIENCE IS A CAREER FOR YOU?			
C-1 Consider the Different Places People Work and Things They Do in Science	Exploration of where people in science work, five examples. (Transparency) Optional: Brainstorming about where science takes place.	MICROBIOLOGIST/LIMNOLOGIST PATHOLOGIST/BOTANIST GENETICIST OCEANOGRAPHER ANTHROPOLOGIST ARCHEOLOGIST ENTOMOLOGIST/BOTANIST	GERALD MICHAEL McCARTHY*
C-2 Think About What Training/Education You Would Need	Exploration of various training/education options available before and after high school graduation. Optional: Word search puzzle.	ANTHROPOLOGIST CHEMIST	JANE van LAWICK-GOODALL LOUIS LEAKEY EDWIN J. PARKS*
C-3 Invite a Guest Speaker	Guest speaker discusses his or her science career.	STEREOCHEMIST	SIR JOHN CORNFORTH*
C-4 Go Out and See for Yourself	Field trip to local science industry or institution. Optional: "Shadowing" a science worker.		
C-5 Write for Information	Opportunity to write letters to acquire information regarding science careers. Optional: Seeking information in person.		
C-6 Keep Up with Science	Journal or scrapbook is started for articles, etc. about science.	LAYPERSONS WHO MAINTAINED STRONG INTERESTS IN SCIENCE	JOHN WILLIAM LOWE* ABRAHAM FARRAR*

*Deaf Scientists

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Objectives

The primary goal of this program is to encourage deaf students to consider science as a possible career. Specific objectives are:

- To develop in deaf students an awareness of their interests, assets, abilities, and needs
- To create in deaf students an awareness of science careers
- To develop in deaf students more positive attitudes towards science and science careers
- To encourage deaf students to explore science content
- To provide deaf students with role models in science careers
- To provide deaf students with opportunities to see people engaged in science
- To enable deaf students to consider and resolve potential barriers to scientific careers

Content Outline

The chart on pages iv and v briefly describes each activity, including optional activities, and lists all science careers and scientists mentioned within that activity. This chart not only gives an overview of the activities, it also helps in planning reinforcement, remedial, and extension instruction. (For example, you may wish to build a lesson, unit, or bulletin board around the theme, "Many Deaf Workers Have Succeeded in Science Careers," and use the listing on this chart for reference.) If a student is particularly interested in a specific area of science or kind of job, you may use this chart to find information for this student.

"Is Science a Possible Career for You?" is divided into three sections. The activities in the first section help the student answer the question, "Why Consider a Career in Science?" Seven activities give students opportunities to learn about their interests and to consider the role of scientific work in society today. In the second section, the activities explore with students, "What Do People in Science Do?" Information about a science career is studied in six activities. Finally, the third section helps students answer the question, "How Do You Find Out If Science Is a Career for You?" Here, through field work and other activities, students explore the possibility of a science career.

Activity Sequences

The activities in this program are not intended to be used in a strictly sequential manner. Furthermore, it is unlikely that any one group of students would complete all of the activities. Rather, each teacher/counselor should select the activities that are best for a particular group of students. To help in the selection, two charts are provided.

The chart on page vii provides a suggested activity sequence if you have an unlimited amount of time. You may begin with the filmstrip (A-1), then proceed to the values clarification activities, which you may select and which can be done in any order (A-2 through A-5). Next, move to Activity A-6 and/or A-7 before going on to Activities B-1 and/or B-2, and continue to the end of the program.

The second chart (found on page viii) shows possible activity sequences based on the amount of time available. It is recommended that if you have only one-half day for science career development, you begin with the filmstrip (A-1) and then go on a field trip to a local science industry (C-4).

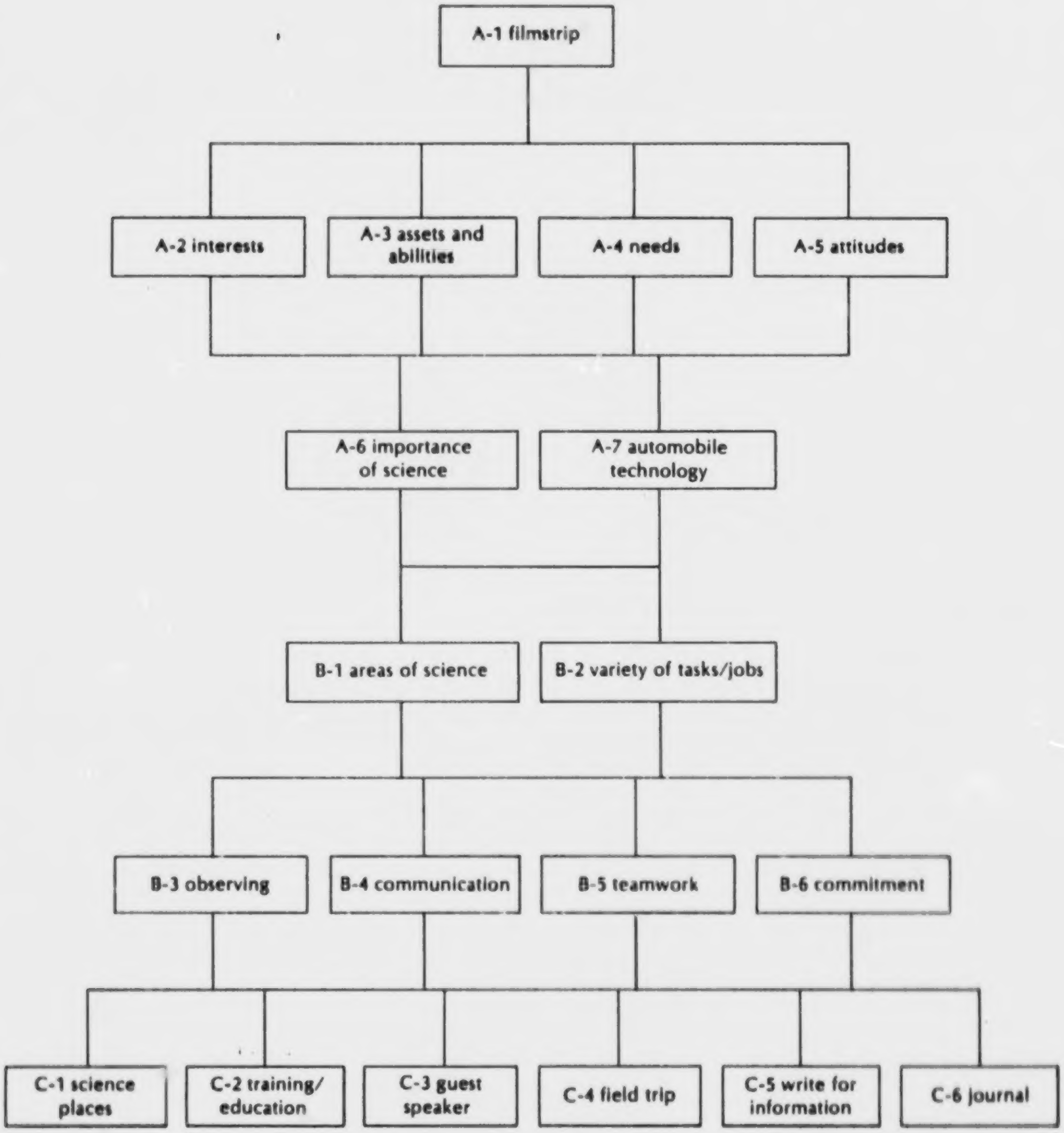
If you have only one day or one week of five class periods, you should begin with the filmstrip (A-1), do one of the values clarification lessons (A-2 through A-5), complete Activity B-1 describing the fields of science, go on to Activity B-2 covering the variety of tasks/jobs in science, and finish with a field trip (C-4).

If you will be using the materials for two weeks (one class period per day), it is recommended that you follow the sequence outlined for one week and add either Activity A-6 or A-7; Activity B-3; Activity B-4, B-5, or B-6; Activity C-1, C-2, or C-3; and Activity C-5 or C-6.

It is hoped that these outlines of possible activity sequences will provide you with enough information about suggested priorities that you can easily plan a sequence for your students.

The last activity (C-6) gives students an opportunity to start a science journal or notebook. The journal has three aims: to heighten students' awareness about current scientific developments, to focus their attention and document their current feelings and ideas for later reference, and to demonstrate that science is important to everyone, not just to those who seek science careers.

SUGGESTED ACTIVITY SEQUENCE

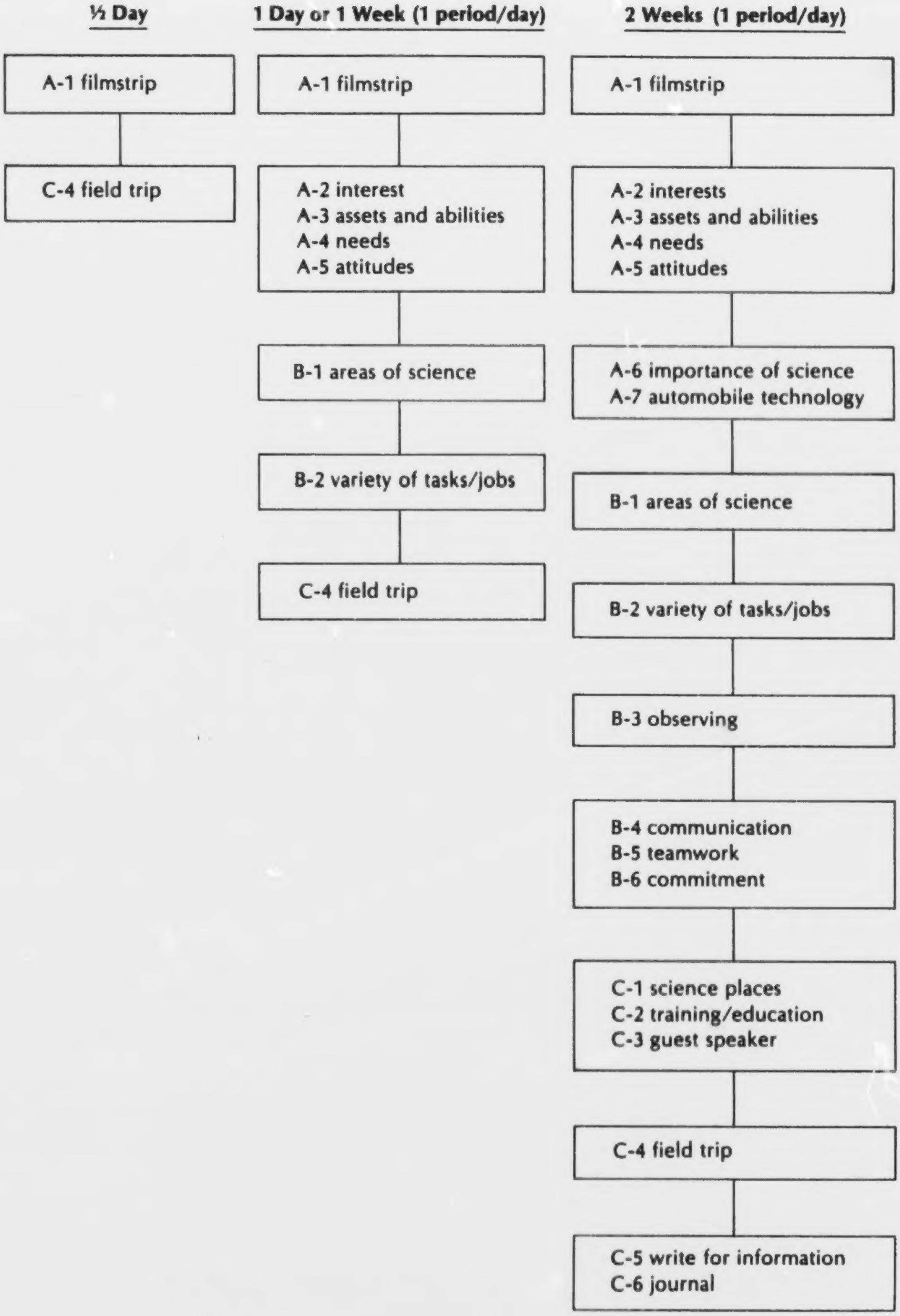

A-1 filmstrip
A-2 interests
A-3 assets and abilities
A-4 needs
A-5 attitudes
A-6 importance of science
A-7 automobile technology
B-1 areas of science
B-2 variety of tasks/jobs
B-3 observing
B-4 communication
B-5 teamwork
B-6 commitment
C-1 science places
C-2 training/ education
C-3 guest speaker
C-4 field trip
C-5 write for information
C-6 journal

Even before your students reach this last, important activity, you can help them in several ways:

- Become aware yourself of current developments in science.
- Share newspaper and magazine articles which discuss current developments in science.
- Make a bulletin board of interesting articles and discuss the articles with your students.
- Keep a journal yourself (see Activity C-6) and leave it in the classroom where your students can read it.

You might find that your students would like to keep a journal throughout the program, so consider doing Activity C-6 as one of the first activities. The advantage in doing it first and continuing the journal throughout the program is that students might find ideas and articles that interest them. A journal would be a place, like a scrapbook, for your students to keep interesting clippings and personal notes about science.

POSSIBLE ACTIVITY SEQUENCES


½ Day
A-1 filmstrip
C-4 field trip
1 Day or 1 Week (1 period/day)
A-1 filmstrip
A-2 interest
A-3 assets and abilities
A-4 needs
A-5 attitudes
B-1 areas of science
B-2 variety of tasks/jobs
C-4 field trip
2 Weeks (1 period/day)
A-1 filmstrip
A-2 interests
A-3 assets and abilities
A-4 needs
A-5 attitudes
A-6 importance of science
A-7 automobile technology
B-1 areas of science
B-2 variety of tasks/jobs
B-3 observing
B-4 communication
B-5 teamwork
B-6 commitment
C-1 science places
C-2 training/education
C-3 guest speaker
C-4 field trip
C-5 write for information
C-6 journal

The Teacher/Counselor Guide

The activities themselves are designed as teacher-led discussions to be used with small groups, where much of the direction for the activity can be based on students' individual experiences. This format should also give students opportunities to learn new science/career vocabulary.

For each activity, the Purpose is stated, Materials needed are listed, and a Discussion provides background information for the teacher/counselor. Guidance for conducting the Activity is given in a question-and-answer format which suggests how the activity might progress.

Optional Activities are provided for most lessons. Since these usually expand upon some point in the main activity, they are meant for students with a demonstrated interest in science and/or strong language skills.

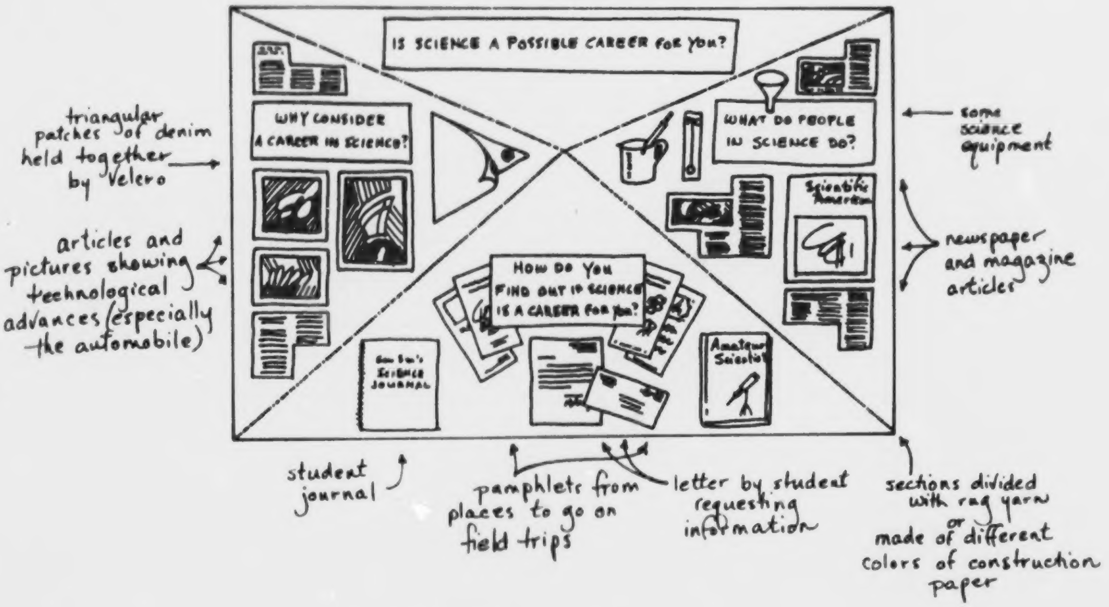
Notes and Comments give information about topics covered within the activity, such as remarks about deaf individuals presently in science-related careers. Teacher References suggest books and articles for exploring a particular topic in greater detail. Also included are sources of brochures or other materials to share with your students. The Suggested Student Reading section lists references for your students; the annotations for each entry will guide you in determining its appropriateness for an individual student.

Bound in this teacher/counselor guide are eight transparencies on heavy plastic and four "master" pages on white paper. When needed, the transparencies and "master" pages should be cut out of the guide as tearing them out would destroy the binding of the book. Use the transparencies with an overhead projector. Make handouts for your students from the "master" pages by making a ditto master or by using a photographic copying machine.

Bulletin Board

And finally, it is suggested that a short time before you begin this career development program, you put up a bulletin board to help arouse interest in science careers and the activities that you will be doing. This could be done in coordination with the librarian so that various books on science, or scientists, or science careers could be featured. Depending on the activities that you are planning (which sections you will be stressing), you may want to prepare a bulletin board under the general title "Is Science a Possible Career for You?" or select one of the section titles (i.e., "How Do You Find Out if Science Is a Career for You?") to use as your theme.

If you use the program title "Is Science a Possible Career for You?" you could divide the board into sections which could have the headings: "Why Consider a Career in Science?"; "What Do People in Science Do?"; and "How Do You Find Out if Science Is a Career for You?" The following sketch may give you some ideas.


IS SCIENCE A POSSIBLE CAREER FOR YOU?
WHY CONSIDER A CAREER IN SCIENCE?
WHAT DO PEOPLE IN SCIENCE DO?
HOW DO YOU FIND OUT IF SCIENCE IS A CAREER FOR YOU?
Scientific American
Amateur Scientist
SCIENCE JOURNAL
triangular patches of denim held together by Velcro
articles and pictures showing technological advances (especially the automobile)
some science equipment
newspaper and magazine articles
student journal
pamphlets from places to go on field trips
letter by student requesting information
sections divided with rag yarn or made of different colors of construction paper

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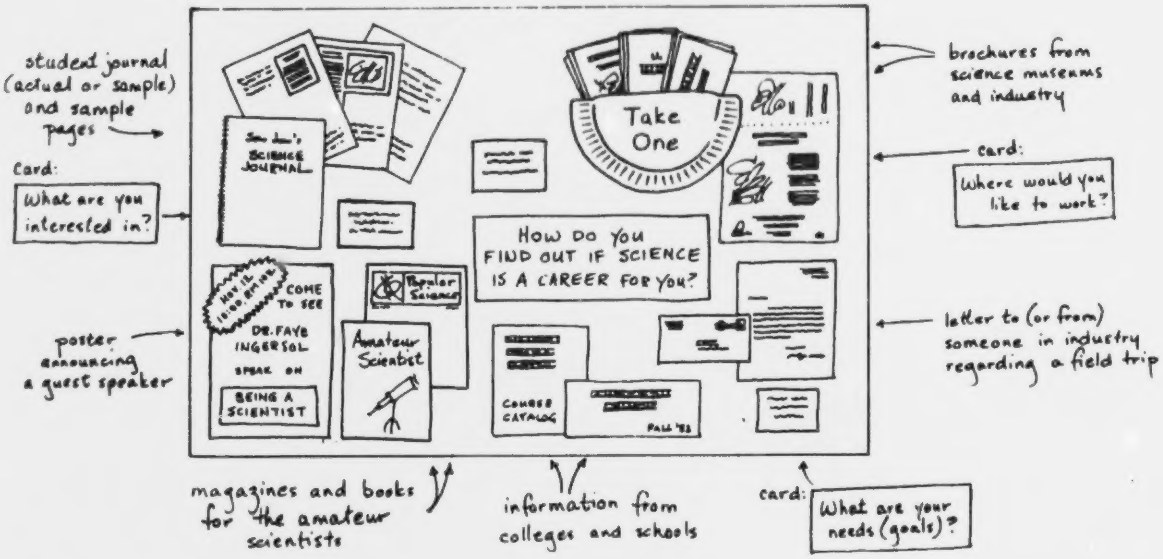
If you use a section title, as for example, "How Do You Find Out if Science Is a Career for You," you could set up a bulletin board that would look something like this:


student journal (actual or sample) and sample pages
Card:
What are you interested in?
poster announcing a guest speaker
NOV. 12 10:00 RM 106
COME TO SEE
DR. FAYE INGERSOL
SPEAK ON
BEING A SCIENTIST
SCIENCE JOURNAL
Popular Science
Amateur Scientist
Take One
HOW DO YOU FIND OUT IF SCIENCE IS A CAREER FOR YOU?
COURSE CATALOG
FALL '83
brochures from science museums and industry
card:
Where would you like to work?
letter to (or from) someone in industry regarding a field trip
magazines and books for the amateur scientists
information from colleges and schools
card:
What are your needs (goals)?

Once your students are working in the program, discuss the bulletin board with them. Suggest to your students ways that the material displayed helps to answer the question(s) raised by the title of your bulletin board display.

A. Why Consider a Career in Science?

Activity A-1: SCIENCE OFFERS CAREER OPPORTUNITIES FOR DEAF STUDENTS

Materials

Filmstrip: "Deaf People Work in Many Science Jobs"
Filmstrip Projector
Copies of "Biographies of the Filmstrip Scientists" (optional)
Copies of "Some Thoughts from the Filmstrip Scientists" (optional)

Purpose

To show that science-related work offers possible and attractive career opportunities for deaf students.

To provide real life examples of the type of work deaf individuals are doing in science-related careers and of the rich and varied lives they lead.

To demonstrate the ways in which some deaf individuals in science careers adapt their work and personal lives in order to compensate for their deafness.

Discussion

The science career opportunities for deaf students are almost limitless. Deaf individuals can and do fill positions in almost all kinds of science-related occupations. However, the number of deaf individuals currently employed in such jobs is still relatively small. Deaf individuals remain a virtually untapped source of talent to fill the multitude of science-related jobs created by our increasingly scientific and technologically oriented society.

This gap between the science career potential of the deaf and their actual employment is largely due to a lack of awareness of this potential on the part of deaf students and those who encourage and direct their studies. The purpose of these materials, therefore, is to create such an awareness; for, if these students see the career opportunities available to them, they will be encouraged to pursue studies in the science-related fields and, thereby, qualify themselves for employment in these areas.

This activity is designed to give your students concrete evidence that deaf individuals can and do fill a wide variety of positions in science-related careers and to show the types of environment in which they work and some of the ways in which they adapt their work and personal lives in order to compensate for their deafness. The individuals shown in the filmstrip can also serve as role models of deaf people in scientific careers, leading full and productive lives both in and out of their work environment.

Before you begin this activity, you may want to read the "Biographies of the Filmstrip Scientists" which can be found on page 6 so that you will be better able to answer your students' questions about the individuals who are shown. (If your students are good readers, you may wish to let them read the Biographies themselves either prior to viewing the filmstrip or after this viewing if they wish further information.)

Activity

You are going to see some slides about six individuals who have careers in science. All six individuals are deaf.

- **One studies milk.**
- **One studies the brain.**
- **One studies plastics.**
- **One studies the weather.**
- **And two work with computers.**

All six scientists are also happy, busy people.

- **One is a champion bowler who also builds TV sets.**
- **One has traveled all over the world and has now begun to paint pictures.**
- **One spends almost all his free time helping other people.**

- **One goes skiing about twice a week.**
- **One is a jogger who flies airplanes and has his own telescope, which he uses, together with his camera, to study planets and storms.**
- **And one dances with an Afro-American dance ensemble.**

Think about these questions as you watch the slides. It may be helpful to write these questions on the board so your students may refer to them while watching the filmstrip.

DOES DEAFNESS SEEM TO INTERFERE WITH THEIR WORK?

HOW DO THEY COMMUNICATE WITH THEIR CO-WORKERS?

HOW HAVE THESE INDIVIDUALS ADAPTED THEIR WORK AND/OR PERSONAL LIVES IN ORDER TO COMPENSATE FOR THEIR DEAFNESS?

DO ANY OF THESE SCIENTISTS DO WORK THAT YOU WOULD LIKE TO DO? WHICH KIND OF WORK?

Show the filmstrip. The filmstrip script is given below. The bold type represents the captions on the filmstrip. The words in regular type provide additional information for you to use, depending on the language abilities and interests of your students.

Filmstrip Script

1 **Deaf people work in many science jobs.**
2 **Jay Basch is a chemist in the dairy research division of the U.S. Department of Agriculture at the Eastern Regional Research Center in Wyndmoor, Pennsylvania.**
3 No caption.
4 **Jay Basch studies milk.** He is trying to develop new products from milk, such as instant milk, milk powder, etc.
5 **This is one kind of equipment that he uses.**
6 **He sometimes works in a special cold room.** This room is like a big walk-in refrigerator. Scientists must do some experiments at low temperatures to control the growth of bacteria and other organisms.
7 **Sometimes he works with a technician...** Many experiments require two or more people working together.
8 **or he goes to other labs to see what scientists are doing there.** These are tanks of sewage used to study pollution.
9 **He shares the results of his experiments with his co-workers.** Scientists often share their findings and get advice from each other.
10 No caption. Scientists also have meetings to share information. Here Basch uses a diagram as well as his voice. His co-workers are used to his voice and can understand him well.
11 **He also shows his findings in reports.** Scientists write down what they find out. In this way, they can share information with scientists all over the world.
12 **And part of his job is to train young chemists.** This student is an intern on a work-study program from Drexel University.
13 **His hobby is bowling.** His whole family bowls. He and his wife have won many bowling trophies.
14 **Another hobby is building TVs.** He studied chemistry in school, but he is also interested in other areas of science. He studies electronics at home. Notice the diagram on the wall which he uses to help him build the TV.
15 **He built this TV.** The TV that he is building now is the third set that he has built.
16 **He also likes to show captioned films.** He invites friends in each month to watch films at his home.
17 **This is his family.** His wife is partially hearing. He has two hearing children.
18 No caption. You see, not all scientists are bookworms.
19 **Nansie Sharpless is a biochemist at Albert Einstein College of Medicine in New York City.**
20 **Nansie Sharpless studies about the brain.** She wants to find out more about how it works.
21 **She spends a lot of time reading and writing about the brain.** She reads to get information

about what other researchers are doing. She puts this information together to get new ideas for experiments.

22 **Some brain experiments are done with rats.** She uses animals for experiments. Human beings cannot be used at first. Can you see a little rat in the open cage?

23 No caption. Rats have brains very much like humans. You can see that each rat has its own cage and separate feeding system.

24 **She has her own laboratory.** Here she is measuring out quantities of spinal fluid before beginning an experiment. Her technician usually does this work.

25 **She uses many kinds of equipment.** This evaporator is used to concentrate dilute solutions to a smaller volume. Traces of substances are easier to find in a small volume.

26 No caption. The centrifuge spins to separate the different materials in a substance.

27 No caption. A gas chromatograph is used to study the composition of mixtures. She injects a liquid mixture into the machine. It is heated hot enough to become a gas. The gas flows through a long column of liquid. The different compounds in the mixture flow through the column at different rates. The machine records the amount of each compound present as it flows out the end of the column.

28 **She shares information with others.** She uses lipreading and speech for face-to-face communication.

29 No caption. Here she jokes with the technician in her lab.

30 **At home she has her own TTY.**

31 **She has traveled to many countries.** She has been to Japan and Russia as well as to Egypt and to many countries in Europe and South America.

32 **She brings back souvenirs.** Here are a vase from Mexico, an ostrich egg from Africa, and dolls from Japan, Ecuador, and Peru. The dolls she is holding are made out of bread.

33 No caption. This picture is really a piece of Japanese silk. It was a gift from a friend in Japan. Notice the view out the apartment window. Her apartment is in a very tall building.

34 **Painting is her new hobby.** She has been painting for only a short time. To the left of her shoulder, you can see the black-and-white picture she is copying.

35 **William Pickhardt is a microanalytical chemist at E. I. du Pont de Nemours & Company in Wilmington, Delaware.**

36 **William Pickhardt works in one section of a large laboratory.**

37 **He reads about the work of other chemists.**

38 **All of his work must be carefully done.**

39 No caption. Here he uses a very sensitive balance. This scale is so delicate it can be used to determine the mass of a hair. The chamber is glass-enclosed so that air currents do not affect it.

40 **He does some experiments at very high temperatures.** Both chemists are wearing safety glasses. They are working behind a safety shield which can drop down to protect them in case of an accident.

41 **He uses a computer to study his findings.** There is a computer center right in the building where Pickhardt works. The computer can give a quick analysis of lab results.

42 No caption. Here the chemists are studying computer information shown on a screen.

43 **He designed this piece of equipment.** It is used to analyze plastic material. Pickhardt is on the right.

44 **He explains its use to his boss.** The boss is the man on the right.

45 **He often meets with his boss.** He tells about the new things he has found.

46 **He has a secretary to help with telephone calls and other things.** Telephones do not stop a person from working.

47 No caption. Here he explains what he would like her to do.

48 **After work he often helps at the local Mental Health Association.**

49 **He is their advisor for work with the deaf.**

50 **He works with the deaf in other ways, too.** Children love the special events he plans for them. He wrapped each of the presents himself.

51 **Here it's a game of bingo.**

52 **"B7. Who's got it?"**

53 **At home he relaxes with his dog.**

54 **Darcy Slappey is a senior systems analyst in the data processing department of The Travelers Insurance Companies in Hartford, Connecticut.**

55 **Darcy Slappey works in computer science.** This is the main entrance of the Travelers office in Hartford, which includes one of the largest private data processing centers in the country.

56 **Computer information is often stored on electromagnetic tapes.** The tapes can be mounted on the computer whenever an authorized employee wants to see the information that is on them.

57 **The information is displayed on a computer terminal.** The terminal is made up of a keyboard, much like a regular typewriter keyboard, on which the user types in a request for information. In the computer center, the computer operator gets the request. He or she mounts the tape that contains the needed information. The computer then processes this tape and selects the information that has been requested. The information is then displayed on the TV-like screen of the user's terminal.

58 **Darcy Slappey's job is to find out what information other employees will need from the computer.** Here she discusses the kind of data one department is collecting and finds out in what ways they will want to study that data later on.

59 **She designs flowcharts to show how this information will be processed by the computer.** She will design a system that will allow its users to retrieve their information easily and to study it in new ways.

60 **She gives these flowcharts to computer programmers.** When she has designed her system, she explains it to computer programmers. The programmers will take her design and write it into a computer language known as COBOL-Common Business Oriented Language. She needs many programmers to carry out the various parts of her design. She may have five or more programmers working for her on a single project.

61 **She also explains her plans to her boss.** They discuss schedules, program designs, and any problems that may come up.

62 **She also discusses her work at staff meetings.**

63 **Here she talks with another deaf employee.**

64 **Her company provides a TTY for its deaf employees.**

65 **At work, there are opportunities to relax in a lounge...** Here she is talking with a member of the personnel department who works with handicapped workers.

66 **or at lunch in a company cafeteria.**

67 **At home, she reads with her husband...** He is also deaf.

68 **plays with her dog,..**

69 **or prepares for a ski trip.** She is waxing her skis. First she melts a piece of wax onto the bottom of the iron, then "irons on" the wax.

70 No caption. The Slappeys live only 20 minutes from a ski slope. In the winter, they ski about twice a week and go to other slopes for long ski weekends as often as possible.

71 **Charles Vlcek is a meteorologist at the National Weather Service, a division of the National Oceanic and Atmospheric Administration in Camp Springs, Maryland.**

72 **Charles Vlcek studies weather information.**

73 **He sees what weather information has been collected.**

74 **He studies this information.**

75 **He types new information onto punch cards.** He is using a keypunch machine.

76 **Then he puts the cards into a computer.** The new information is added to the information already in the computer. It can be analyzed with other information now or later.

77 **Weather information is also put on maps.**

78 **Meteorologists follow storms and temperature changes to make predictions.** Changes in temperature indicate changes in weather.

79 No caption. Meteorologists put together information from many maps to decide what the weather will be.

80 **One of Vlcek's hobbies is flying.** He flies a Cessna 172.

81 **He also likes to listen to his stereo**... He has an 80dB hearing loss.

82 **or he reads about astronomy.**

83 **He has his own telescope.**

84 **He can attach his camera to the telescope to take pictures**... He takes pictures through the telescope.

85 **like this picture of the moon**... You can see the "rays of Tycho" like the rays on a tomato when it starts to get ripe.

86 **or this eclipse of the moon.**
87 **He also takes pictures of storms.** You can see the lightning move from the clouds to the Earth.
88 **This is a tornado in Oklahoma.** Vlcek won a national award for his series of pictures of this storm.
89 No caption. He got very close to the funnel of that storm.
90 **This picture of lightning is one of his favorites.** The red dots are navigation hazard lights on water towers near an airport.
91 **Hershella Hearns is a programmer in the data processing department of Continental Bank of Chicago.**
92 **This is Hershella Hearns's first year as a programmer.**
93 **She has her own desk and work area.**
94 **Her job is to study flowcharts written by a systems analyst.** Remember that Darcy Slappey is a systems analyst. Part of her job is to develop flowcharts for the programmers.
95 **She programs the computer to follow the steps shown in the flowcharts.**
96 **She can read the results of her work as they come from the computer printer.**
97 **Or she can study these results later at her desk.** She checks to see if the computer handled the work the way she wanted it.
98 **She keeps all the print-out.** She can look at results from earlier programs to help her write new programs.
99 **She meets regularly with her supervisor and co-workers.** They tell what they have been doing. They help each other solve work problems.
100 No caption. They learn new ways to write programs.
101 **At lunch, she enjoys meeting other young people at the bank.** Notice the tree in the background. The company cafeteria looks like an outdoor garden with flowers and trees. Sunshine comes through the roof, which is made of glass.
102 **Lunchtime is a time to relax.** This is a stairway coming from the cafeteria.
103 **After work, Hershella studies dance.** She has been studying dance for years.
104 **She is part of an Afro-American dance ensemble.** This group performs in the Chicago area.
105 No caption. Energy and enthusiasm shine through her whole day.
106 **These people all live full and interesting lives.**

Discuss the filmstrip with your students. Remind them of the questions on the board.

Does deafness seem to interfere with their work? How do they communicate with their co-workers? How have the individuals in the filmstrip adapted their work and/or personal lives in order to compensate for their deafness? These questions should be answered from the personal perspective of each student. For the last two questions, elicit such examples as the use of lipreading, TTY, visual aids, graphs, diagrams, visual displays of data, secretaries and assistants (e.g., for communicating with others outside the lab) as well as the use of a TTY, stereo headphones, signing, etc., during leisure time.

Do any of the individuals in this filmstrip do work that you would like to do? What kind of work? Get each student to participate. Have the students express their interests and their feelings about their capabilities.

Show the filmstrip again if your students would like to see it or allow individual students to view it during free time.

Optional Activity 1

Purpose: To gain further insight into the preparation, work, and other interests of the six filmstrip scientists.

Your students may be interested in reading and/or discussing the background information provided in "Biographies of the Filmstrip Scientists" (see page 6). If so, you may want to reproduce this material for reading and discussion. Have students note how much and what kind of training these individuals have had to prepare for their jobs and what they are doing to open opportunities for other handicapped people.

Jay Basch

Jay Basch grew up in Philadelphia, Pennsylvania. Deaf from birth, he was a student at the Pennsylvania School for the Deaf (PSD) through the end of ninth grade. His last three years of high school were spent at Friends' Select School, a small Quaker school in Philadelphia.

An early household experiment in making soap and a visit to the Academy of Natural Sciences in Philadelphia at the age of seven began his lifelong interest in science and scientific investigation. Basch's father, a chemical engineer, encouraged this interest.

Basch read a lot during high school and, by the time he was ready for college, he was ready to tackle a science and math program at the University of Pennsylvania. However, after graduation, he found it rather hard to get a job because some people did not want to take a chance on hiring a deaf person in the chemical field. Finally, he got a job working for the government and soon he began night school at Drexel Institute of Technology, where he earned his masters degree, then went on to get his Ph.D. at Temple University.

He has been a research chemist for the Department of Agriculture for the past twenty-one years. He is currently working on a project to understand more about milk and to make new products to provide more nutrition for hungry people of the world. In 1969, he was named the Handicapped Federal Employee of the Year.

He is a member of the Silent Athletic Club. A past president of the PSD Alumni Association, he is currently on the PSD Board of Trustees. He is also married and the father of two children. A favorite hobby is building TV's. (So far, he has built two black-and-white sets and one color set.)

Nansie Sharpless

Born in Pennsylvania, Nansie Sharpless lived near Detroit, Michigan, until she and her family moved to New York state when she was 13. The same year, she contracted meningitis and has been deaf ever since. Only two months after her illness, she returned to her regular ninth grade classes. At the same time, she started lipreading lessons at the New York League for the Hard of Hearing, then continued with a private teacher. At 16, she entered Westtown School, a coeducational Quaker boarding school near Philadelphia. She graduated from Westtown two years later.

Her father was a biochemist and she visited his laboratory as a child. Her parents both encouraged interest in science by taking her to science and natural history museums, by providing books and toys on scientific subjects, and by showing approval of science and mathematics. Many of her parents' friends were also professionals in science or medicine. She had exposure, approval, and models.

Sharpless received her B.A. degree in zoology from Oberlin College, an M.S. degree in medical technology from Wayne State University, and a Ph.D. in biochemistry from Wayne State. She currently directs a biogenic amines assay laboratory for the Departments of Psychiatry and Neurology at Albert Einstein College of Medicine in New York City.

She is active in the Oral Deaf Adult Section of the Alexander Graham Bell Association for the Deaf and in the Advisory Group to the American Association for the Advancement of Science (AAAS) Project for the Handicapped in Science. Partly through her efforts, AAAS is now providing interpreters for the deaf at their annual meetings.

She has also won several awards for her lipreading abilities and has made many speeches on her experiences as a deaf adult. Her hobbies are painting, photography, sewing, and reading. She's traveled extensively: Eastern and Western Europe, Russia, Japan, Central America, Canada, Mexico, Peru, Ecuador, and Egypt.

William Pickhardt

Deaf from birth, Bill Pickhardt was born in New York City in 1920. Brought up in the oralist tradition, he attended the Clarke School for the Deaf in Northampton, Massachusetts, then went to the Collegiate School in New York City. He received both his B.S. and M.S. degrees in analytical chemistry from Yale University.

Pickhardt grew up in a family with strong ties to science. His grandfather and one uncle were in business and had strong backgrounds in dye chemistry. His father was a surgeon.

As a child, he wanted to be either an astronomer or a spaceship builder. As a teenager, he longed to be a veterinarian. But in college, he majored in analytical chemistry because he "thought it would provide better opportunities in the working world."

For the past thirty years, Pickhardt has worked for E. I. du Pont de Nemours & Company. A microanalytical chemist, his work includes:

- determination of trace amounts of elements or substances;
- development of chemical and electrochemical procedures for analysis of plastic products and resins;
- utilization of expertise in operation and preventive maintenance of a fully automated wet chemical analysis system (the only one of its type in operation in the Du Pont Experimental Station); and
- provision of analytical support as needed on research, manufacturing, and sales problems.

Outside of his job at Du Pont, Pickhardt's seemingly boundless energies are devoted to helping other deaf individuals. He learned sign language as an adult in order to communicate with other deaf individuals and is now an active member of more than a dozen organizations serving deaf people. A resident of Wilmington, Delaware, much of his work is carried out through the Mancus Foundation and the Delaware Mental Health Association.

The Mancus Foundation was set up in the 1940's as the Delaware social organization for the handicapped. About ten years ago, Pickhardt formed an activities program for the deaf, which he continues to direct.

At the Mental Health Association, his committee plans and advocates the development of mental health programs to provide the hearing-impaired in Delaware with an adequate background to solve their emotional needs and problems.

With enormous amounts of patience, understanding, and good humor, he also provides comprehensive lay counseling to deaf persons with minimal communication skills. He helps them solve the problems and cope with the tensions and stresses of everyday living. He also works to teach deaf people to communicate effectively; to learn to apply themselves; to explore new, challenging areas of educational, work, social, recreational, and religious activities; and to become community participants.

Darcy Slappey

Darcy Slappey was born in Baltimore, Maryland, and grew up in York, Pennsylvania. She attended public schools in York until her graduation in 1969. She then went to Gallaudet College, where she majored in math and took several computer science courses as electives. She applied her knowledge of BASIC computer language to both math and statistics courses and thus became interested in computer science.

In September 1973, she was hired as a programmer for The Travelers Insurance Companies and enrolled in a seven-week training program which is offered to all new programmers who are not familiar with the programming languages and data processing equipment used at that company. Since then she has attended many other training sessions at The Travelers.

In her capacity as a Senior Systems Analyst in the Data Processing Department, she does analysis (program and system), controls the work queues, assigns tasks to programmers, monitors production, and supervises the work of programmers.

Her favorite activity is skiing. She takes several weekend trips a year to Vermont, Maine, and Canada. During the work week, she often goes night skiing at a local ski area. She spends her time in the summer enjoying the country air while tending her garden and the lawn at her home in Simsbury, Connecticut. Also, she and her dog, Kara, take frequent walks in the nearby woods. If there's spare time, she'll often find herself reading a novel that she has selected from the local library.

She was a panel member of On-the-Job Problems and Solutions at the 1975 Conference on Computing Careers for Deaf People, Association for Computing Machinery, Special Interest Group on Computers and the Physically Handicapped, held in Washington, D.C.

Charles Vlcek

Charles Vlcek was born in Roseburg, Oregon. Having an 80 dB rubella-related hearing loss, he received preschool training at the Speech and Hearing Center in Washington, D.C., and attended kindergarten and first grade at the Bruce Street School (for hearing impaired) in Newark, New Jersey. After first grade, he returned to Oregon and spent the next years in small Oregon public schools. He later attended The Hill School, a small private school in Pottstown, Pennsylvania, from the age of 15 until he graduated at the age of 18. From The Hill School, he went to the University of Washington in Seattle, where he graduated with a B.S. in Atmospheric Sciences in 1967.

His interest in meteorology dates from his watching nighttime thunderstorms with his father at the age of four. His interest in astronomy began in third grade when he first read about planets and witnessed a total eclipse of the moon. By sixth grade, he was observing weather regularly. He feels his hearing loss greatly contributed to these interests for, in both astronomy and meteorology, the emphasis is on visual observations. Also, because he could shut off sound, he was able to read a great deal.

After college he worked at the National Severe Storms Laboratory in Oklahoma. In addition to working with computers, this job included some "storm chasing" to provide on-the-scene reports and photographic records. Later he came to Washington to work, first in Surface Analysis, then in Systems Evaluation Research for the National Weather Service. He still does some "storm chasing" for the Weather Service.

His spare time is devoted mainly to jogging, flying (he has a pilot's license and flies a Cessna 172), photography, astronomy, science fiction, and verse writing. He also belongs to many organizations, including the Washington Area Group of Hard of Hearing (elected to a one-year term as president in June 1978), the National Capital Astronomers Club, the Sierra Club, and the American Meteorological Society (local chapter). In the fall of 1976 through the spring of 1977 he was heavily involved in the White House Conference for Handicapped Individuals and was a Maryland delegate to the National Conference in Washington, D.C., in May 1977, for which he received a citation from the acting governor of Maryland.

Hershella Hearns

Hershella Hearns was born in San Francisco, California, and lived in that area until she went to Gallaudet College. She received a B.S. degree in Business Administration from Gallaudet in 1977.

While in college she received the Chevy Chase Women's Club scholarship, won the title of third runner-up in the 1975 Miss Gallaudet Pageant, was a member of the Gallaudet Dancers for five years, and was a sister of Chi Omega Psi Service Sorority. While at Gallaudet, she majored in accounting and took a course called "Introduction to Business Data Processing." She enjoyed this course so much that she decided to make her career in data processing.

She is currently a computer programmer at Continental Bank in Chicago and a member of Julian Swain's Inner City Dance Theatre.

Her special interests are dancing, especially disco dancing, swimming, bike-riding, macrame, and traveling.

Optional Activity 2

Purpose: To explore the personal thoughts of some deaf individuals on the subject of pursuing scientific interests and science careers.

Your students may be interested in reading or learning about "Some Thoughts from the Filmstrip Scientists" (see page 9).

The first section, "Don't let deafness stop you!" encourages students to work to fulfill their potential and points out some ways in which deafness can actually help an individual to succeed in a scientific career.

"If you are interested in computer science" and "If you decide to take courses at a college for hearing students" offer specific advice to students.

"How one person handles deafness at work and in her personal life" and "Some problems and solutions in the world of work" offer some general observations about possible difficulties and suggestions for handling them. The overall tone of this section is realistic, but positive.

The last section, "Some experiences of one deaf scientist," details some particular experiences from the life of one of the filmstrip scientists, Charles Vlcek. His writings about using his first pair of binoculars, "storm-chasing" in Oklahoma, and learning to fly will provide your students with some interesting insights into a fascinating person.

You may wish to present portions of this material yourself or may choose to reproduce all or portions of the material for use by individual students. After finishing this activity, students may wish to review the filmstrip, especially if they have the additional information on Vlcek's experiences, since some of his telescope and "storm-chasing" photos have been included in the filmstrip.

Don't let deafness stop you!

There is no reason to believe that you cannot have a rewarding career in science just because you are deaf. You will have to work very hard to get the needed training, but it is worth it. What area of science you go into depends on what you like to do best, and I cannot tell you what that is. I have had two different careers in science, and I have liked them both. There is plenty of room for deaf people in all branches of science. (N. Sharpless)

....

The thing that has helped me in the past few years is that I know what I want and I know where I'm going. You have to shake the attitude that "hearing" people won't like you or want to work with you because you're deaf. You have to stop worrying about what other people think. You're in a job position that is also held by others, and you'll just have to prove you're as good as the next guy, the same as he or she has to prove it. (D. Slappey)

....

In retrospect it appears that the very fact of my hearing loss played a large part in [the development of an interest in science]. My experiences were largely visual and, without distracting sounds, I could become totally absorbed. The total absorption process worked on the intellectual level, too, as I could shut out the distracting sounds of the real world whenever I was reading. (C. Vlcek)

....

There are several ways in which deafness has been an asset. Deafness has provided me with the drive to achieve. Genius is, after all, about 90 percent perspiration. A great deal of strength is obtained through constantly trying to win against what is hard. This same kind of persistence is a very valuable asset in my research. In research, one is constantly faced with experiments that have failed. In many cases, all that is needed for success is a slightly new approach. One must have the ability to pick up the pieces and try again. In winning despite the barrier of deafness, I have developed the ability to stick it out. I am also obtaining vast rewards in terms of personal satisfaction with my work. (N. Sharpless)

If you are interested in computer science:

Get good grades; take as many computer science courses as possible; and go out and get the job you deserve. (D. Slappey)

....

If you want to seek computer science as a career, don't let your hearing loss interfere. It takes your brain, not your hearing, to do the job. (H. Hearns)

If you decide to take courses at a college for hearing students:

If you have the intellect and willingness to work a little harder than average, go ahead with your pursuits, but be well prepared beforehand -- not a lot of extra effort is needed, but it should be well placed.

Get a good advisor -- one who can and will learn your needs and help you fill them (by selection of courses, professors/teachers, etc.).

Discuss your needs with the teacher/professor at the beginning of a course; get a seat up front; find out how good a speaker he/she is, how much emphasis there will be on lecture materials, whether such material is available in written form (blackboard or handouts), etc. Let him/her know that you would be lost in a group discussion, that you might not be able to take notes and follow the lecture simultaneously, that if you have to strain to follow what is going on, you will tire before the class is over. Ask him/her to inform you personally of class announcements (changes of class schedule, tests, special assignments, etc.). I got a low grade in a math test because I did not realize that it was "open book" [test] and had not even heard of such a thing. I also missed a class because its location was changed and I didn't hear the announcement.

If you do enlist the help of a classmate, try to have something to offer in return. In one class I had made an excellent study outline from the text book which I exchanged for lecture notes.

If you want to tape a lecture, fine. I'm no authority on it as I couldn't afford a recorder then. But be aware that transcriptions are time consuming and the recording may be inadequate. Some classes offered lecture transcripts (verbatim) on a subscription basis.

If uncompensable difficulties appear in the first two weeks of class, don't hesitate to withdraw or transfer if possible -- to get a better professor/teacher or climate. If that can't be done, take the course for audit first. I haven't done this, but there were a couple of times when I probably should have. (C. Vlcek)

....

Don't neglect your social life. Join some clubs and sports activities. Read up on them. Ask other members to help you learn the skills or practice.

Ask for jobs to do on committees and work at it. I was on the stage and costume committees of the Gilbert and Sullivan players. Follow your own tastes. But join something. Don't run home every weekend or depend on your family for your social life. (N. Sharpless)

How one person handles deafness at work and in her personal life:

Being deaf in a world oriented to hearing is not all frustration. There are many things which I can do for which deafness is no impediment. In some cases, it has actually proved to be an asset.

For instance, I travel quite a lot. I thoroughly enjoy visiting new places and trying new things. I have traveled in the United States, Central and South America, Japan, and Europe. Last year I went to Moscow and Leningrad and to several of the countries of Eastern Europe. I think, actually, that a deaf person is better off than a hearing person in a country where a foreign language is spoken. Over the years, I have developed the ability to get about without ever having to ask directions. When I enter a strange city, I always acquire a map and arm myself with guidebooks. In Russia, my hearing companion depended upon me to lead her about. Equipped with my maps, we traveled all over the cities of Moscow and Leningrad by subway and shopped in stores patronized only by Russians.

Driving is another occupation where deafness can be an asset. I have fewer distractions and my eyes are well trained in observation. I have equipped my car with a radio to keep my passengers occupied so that they will not try to talk to me. I have been driving for over 16 years now and have never had a serious accident. My deafness makes me more alert and cautious than many hearing persons.

My work in the laboratory is also facilitated to some extent by deafness. I have the ability to concentrate my whole attention on what I am doing. I am never interrupted by the page system or by the telephone. Few people bother me with unnecessary questions. (N. Sharpless)

Some problems and solutions in the world of work:

I've never had too much trouble at work dealing with people because of my deafness. Most of my work is done individually or in very small groups. If there's work to be done and you're an important key to it, you aren't going to be "ignored." The group will go out of their way to include you. (D. Slappey)

....

Never be afraid to approach someone because you think there will be a communication problem. The other person will be afraid to approach you for the same reason. We are the ones who usually have to make the first move to say, "It's all right. I will be able to communicate with you."
(H. Hearns)

....

In addition to direct face-to-face conversation, there are other physical barriers imposed by deafness. The most important of these, I believe, is the telephone. Nowadays, the world is practically run on the telephone. Inability to use the telephone is a terrible nuisance, both to me and to the hearing people who are unable to reach me by phone. No one can call me to tell me they will be delayed. I cannot call to make an appointment. I cannot call a taxi to my home. I sometimes spend hours accomplishing some simple task, which a person with normal hearing could have handled in a few minutes by phone.

Of course, I could ask someone else to phone for me. But this is an invasion both of my privacy and of my independence. Furthermore, there are few people who are capable of accurately transmitting a message without unconsciously intruding their own personalities. It is also very difficult for the person on the other end of the line to realize that they are not actually talking to me personally. What they have said will be transmitted to me in the form of an abbreviated, interpreted message. Many almost impossible misunderstandings can result from this.

In order to, at least partially, overcome the phone barrier, I now have a teletype system attached to my phone at home. In this way, I can reach . . . anyone who has similar equipment. I also have a few numbers I can call in case I need an emergency message relayed. At work I have access to a secretary who takes and makes any business calls. This is a great help, but I still prefer the personal contact of a written letter. (N. Sharpless)

....

[Regarding the "phone barrier" mentioned above] TTY's help, and their use is spreading, thanks in part to efforts by the National Association of the Deaf and the White House Conference on Handicapped Individuals. However, I don't use them. I have a hearing aid equipped with a telephone switch which picks up sound via magnetic induction while shutting out conductive sounds (i.e., noises in an office) which works quite well for me. For individuals with sufficient usable residual hearing, this would be preferable to the TTY. Some people with "borderline" hearing may well go both ways, using the phone and hearing aid when the person they're talking to has a good speaking voice. Not all phones are compatible with such hearing aids (and not all hearing aids have these special switches) but there is a movement to make this compatibility a standard feature on all telephones. (C. Vlcek)

....

Hearing people often find it difficult to relate to professionals who are deaf in the working world. The problem is usually not the deaf people's deafness but rather is the negative attitude of the hearing people toward them because of their deafness. Deafness is invisible, and the hearing people usually feel upset by their own lack in communication when they first confront the deaf people. (W. Pickhardt)

....

Deaf people are often treated like children, incapable of responsibility for their own affairs. Women are supposed to be passive, not too competent or independent. But a professional person is supposed to be capable of responsibility, competitive, a leader. As a deaf professional woman, I represent a study in conflicts. I don't fit into any of the neat little career niches that people have been conditioned to. It has taken time for people to get used to me. (N. Sharpless)

....

[Regarding the treatment of deaf people mentioned above] I've occasionally encountered this attitude myself. I think this sometimes stems from situations where the hearing-impaired is unavoidably reliant on others to know what is going on. (C. Vlcek)

Some experiences of one deaf scientist:

Early experiences with binoculars. In the summer following my sixth-grade year (1956) I took a paper route and saved enough money to buy a pair of 7x50 binoculars. It took me a while to hold them steady, but soon I could see the "double" stars Mizar and Alcor in the Big Dipper and the enhanced splendor of the Milky Way. Mars was making its much-heralded "close" opposition of only 35 million miles from earth, and it looked like a ball of fire through these binoculars — to me it was "flaming Mars, king of stars."

Naturally, I was eager to look at the moon . . . I remember looking at a full moon first, with all its seas and rays. (The following summer I "saw" in a ripening tomato the rays of Tycho* -- the similarity is striking.) When I thought of looking at the moon through binoculars, I thought in terms of a full moon, but when I finally gazed upon a first-quarter moon, I was overwhelmed by the spectacular sight of craters and the serrated edge of the terminator. The highlight came in November 1956, when I saw my first "red" lunar eclipse;* the totally eclipsed moon was a brilliant scarlet in a clear, starry sky. (C. Vlcek)

" Storm-chasing" in Oklahoma. Storm intercept techniques are deceptively simple: Forecast a day of severe weather, send out a vehicle equipped with radiotelephone (now 2-way radio) communications, watch storms develop on the radar, tell the interceptors where to go, and let them track the storm visually once they get there. In practice, there are uncooperative roads (that don't go where you want them to), muddy roads, slow-moving vehicles, storms that die when intercepted, poor visibility, intervening storms with heavy rain, fuel stops, mechanical breakdowns, getting lost as the result of looking at the wrong section map, etc.

On May 24, 1973, though, we finally put it all together and successfully intercepted a large tornado that wiped out half of Union City, Oklahoma, as we took slides and movies from a distance of two to seven miles from the funnel* (three miles from Union City). For my photographic efforts (movies of the Union City storm) and for a paper I had published at that time (unrelated to the Union City storm), I received a Special Merit Award ($250 cash); this is my greatest achievement so far.

It was a great challenge, pitting my knowledge of meteorology, navigation, and photography against these monsters. I was also learning a lot about convective storms; it was like being a child again. (C. Vlcek)

On getting a pilot's license. In August of 1970 I attempted to get a medical certificate to fly (as a student pilot) and was told that my hearing was below the minimum requirement -- I think the tolerance was 30dB. One of the people connected with the National Severe Storms Laboratory, where I then worked, was a professor at the University of Oklahoma and a flight instructor. He took me up in an airplane and had me use the radio with earphones and the sound turned up to see if I could follow what was going on. The results were marginal, but he said the reception was not good that day and [he] felt it would work in the long run. He proved to be correct. The aircraft radio is quite powerful and is generally of good quality, so that it well substituted for a hearing aid. I may actually have had an advantage over persons with normal hearing in that I hear very little of the aircraft engine noise that can be a distraction. (A squelch device keeps it from getting into the radio through the microphone, though that also makes it hard for me to hear myself talk.)

In February 1971, I was issued my first medical certificate and so began flying. Instruction was difficult at times because the instructor had to shout over the noise of the plane. (I was wearing a hearing aid then.) Eventually other duties forced [my instructor] to give up instructing for a while, so I was turned over to a friend of his [who] had more time and also did some tinkering with electronics on the side. At my request he built an intercom system with optional radio input... This greatly simplified the instruction process because we didn't have to shout, and for me it was like being in a quiet room on a simulator. That made it much easier to concentrate on flying.

I soloed that summer and for a while flying was easy, because the home airport was "Unicom" which meant that I did not need to receive instructions by radio. When the airport was upgraded to control tower status, I was a bit uptight but learned to ask for and receive clearances. The quality of the transmitter (of the control tower) was better, which helped. Also, there was not too much chatter on the radio, so I could keep up with everything.

I later flew cross-country (defined as a flight more than 25 miles from the home airport and landing in at least one other airport at that distance) and learned to obtain en route weather reports and to file flight plans by radio. Eventually my confidence increased, but I am still leery of landing at busy airports, though I could probably do so if it became necessary to make that adjustment.

On June 6, 1972, I received my pilot's license and have since flown cross-country trips over 400 miles. I have enjoyed orbiting cumulus clouds in Oklahoma and flying into a sunset over Kansas and following the traffic on I-35 below in twilight to Oklahoma City. Such scenes make it worth all the work I put into flying. (C. Vlcek)

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*You may wish to review the filmstrip to see Vlcek's pictures.

Activity A-2: I HAVE INTERESTS IN SCIENCE

Materials	**Purpose**
Copies of Activity A-2 handout Pencils	To provide students with the opportunity to identify and explore the many interests they have and enjoy.

Discussion

This activity is the first of four activities (A-2 through A-5) that focus on promoting self-awareness in the student. They give students a chance to explore the many value-laden issues involved in the decision-making process of career choice. Unless students identify their interests, assets and abilities, needs, and attitudes, it is difficult to understand why one career or another should even be considered.

These activities should be non-threatening and enjoyable. They can provide the students with information about themselves that could lead to the awareness that a science-related career could be a real possibility for them. You can help your students by being accepting and supportive. Be attentive to their responses and help them clarify their thoughts.

An excellent set of games that reinforce the material presented in activities A-2 through A-5 is the Career Insights and Self-Awareness Games (see Teacher Reference). These games foster divergent thinking and focus on interests, life goals, life situations, abilities, the data-people-things puzzle, and the interests triangle.

The two parts of this activity focus on the students' interests. One of the ways students begin to think about possible careers is to determine their interests and what they enjoy doing.

In the first part, students identify and classify interests to determine what they value individually. If you only have the time, or the need, to do one part of this activity, this first part is more comprehensive. The second strategy, using sentence stems, can be used as a full activity, as a follow-up, or in any way that seems appropriate to you. Either or both part(s) will accomplish the objectives of this activity.

Part 1 — Activity

Each of us has special things we love to do. You are going to list as many of these things as you can. It is often helpful to think about each of the seasons in the year to help remember all of the things you enjoy. They don't have to be big or important, just as long as they are fun or satisfying in some way. Distribute handout. Encourage students to try to list ten things. The more things they have, the more significant the learnings from the coding will be. It is often helpful if you put your own list of "Things I Love to Do" on the blackboard to serve as a model. Students tend to share more openly if the teacher is also open. When most students have a reasonable number of things listed, begin the coding activity.

Now we are going to code each of the things on our list. Let's do the first one together. In the first column, put a $ next to everything that costs more than $2.00 every time you do it. If you have your own list on the blackboard, code your list also. When everyone is done, go on to the next code. **In the next column, put an "A" next to everything you do alone.** Allow time for students to do this. **Next, a "P" if you do it with other people.** Allow time. **Place an "N" for everything that has to do with nature, such as plants, animals, outdoor activities.** Wait for students to do this. **Now place an "L" for learning for everything that involves reading, problem solving, following directions.** You may add any code that seems appropriate for your group in the context of the goals of this program.

Do you notice any one code that occurs more often than others? Discuss this with the students, allowing everyone to answer. Point out that the codes, especially N and L, could indicate an interest in science-related fields.

Do the codes tell you anything about yourself? Use the sentence stem, "I learned that I . . . ," to try to summarize your learnings. Students should take turns completing the "I learned" statement with such things as, "I learned that I need money to do things that I enjoy," etc. Make sure that each student has a chance to respond.

Part 2

There are a few ways to do this part. One way is to provide a handout of sentence stems and have students write complete sentences. With the students seated in a circle, you could read a stem and have students volunteer to read their completed version. Do this with all of the stems or those you think are most worthwhile. Another way would be to sit with the students in a circle, read a sentence stem, and have each student respond in turn.

- I wish I could be ...
- I am really good at ...
- I feel happiest when I ...
- If I had a million dollars I would ...
- Doing math is ...
- I feel best when people ...
- I have accomplished ...
- In school I do best when ...
- Someday I am going to ...
- What I love to do more than anything else is to ...

Optional Activity

Purpose: To focus on a specific science career as it may relate to a personal career choice.

If you have students who are already interested in science as a career, you might suggest that they evaluate a specific career. The following sentence stems might help in their evaluations:

- I am interested in this career because...
- I will need to get the following education/training for this career...
- I expect I will work in...
- Ten years after I start this career, I expect I will be doing...

Notes and Comments

James H. Logan, who was deaf, started on a career in science from a special interest in biology. Born in the nineteenth century, Logan began work as a drafter, secretary, teacher, and principal. His work in education led him to write "The Raindrop," a classic book of stories for deaf students. His hobby during this time was biology, and he greatly enjoyed examining microbes from a dredging operation. Soon he turned this special interest into a full career. He became a microscopist for the Pittsburgh office of the Department of Agriculture. His job was to inspect pork for indications of *trichina spiralis*. Although this job lasted only one year, Logan continued his work with microscopes first at the Western Pennsylvania Medical College and later in the Biological Laboratory of the Western University of Pennsylvania. His career continued to be full of variety, from analyzing the water supply of Pittsburgh, to providing microscope analyses for legal cases. Gallaudet College gave Logan, a man who successfully turned an interest into a career, an honorary degree of Doctor of Science in 1914.

Teacher Reference

Munson, Harold L. and Gilbert C. Glockley. Career Insights and Self-Awareness Games. Boston: Houghton Mifflin Company, 1973.

The game leader's manual provides the rationale for the program. Primarily, vocational learning-maturation extends over a long period of time; it develops from "gut" feelings; it requires decision-making; and it relies on experience and compromise. In effect, vocational learning-maturation is an evolving process. Because the games are designed to be fun as well as instructional, they are highly recommended as supplementary material.

Part 1 — Things I Love To Do

	$	A Alone	P People	N Nature	L Learning	Any code you choose
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

Use the back for additional ideas

Part 2 — Sentence Stems

I wish I could be ______________________.

I am really good at ______________________.

I feel happiest when I ______________________.

If I had a million dollars I would ______________________.

Doing math is ______________________.

I feel best when people ______________________.

I have accomplished ______________________.

In school I do best when ______________________.

Someday I am going to ______________________.

What I love to do more than anything else is to ______________________

______________________.

Activity A-3: I HAVE ASSETS AND ABILITIES SUITABLE FOR A SCIENCE CAREER

Materials	**Purpose**
Paper Pencil	To provide a way for students to discover and explore assets and abilities.

Discussion

Each of us has assets and abilities that can help give direction to our career search. There are things that we do well, that give us satisfaction, or that provide us with a feeling of worth.

There are also some things that we enjoy, but do not necessarily do well. There are often ways we could gain competency in these areas with some training.

Yet, besides abilities, there are some special assets that we may have. More specifically, the deaf person does have an advantage over a hearing person in some science careers.

In the first part of this activity your students will pretend that peoples' assets are different from what they actually are. This will enable them to gain new insights into their own assets.

In the second part of this activity your students will have the opportunity to evaluate abilities they have or would like to have. Either or both part(s) will accomplish the objective of the activity.

In some science careers, the deaf person has an advantage. For example, the space and electronics industries value the deaf person's ability to concentrate, especially as the components become increasingly smaller and more difficult to handle. Or some industries have a high noise level which can be more easily tolerated by most deaf persons than by hearing persons. Other jobs require a special sound-proof, dust-free environment which can get on the nerves of some hearing people, but does not seem to bother deaf people.

It should be noted, however, that although deaf individuals have an advantage in certain work areas, hearing-impaired students should be free to explore all areas of science rather than being pigeon-holed into certain areas of science-related employment, as they have been stereotyped in the past into certain vocations.

Part 1 Activity

Fantasy plays a large part in all of our lives. We daydream about the coming weekend, how we will prepare a meal, what conversation with a friend will be like. Our imagination can give us a new perspective on an old situation.

That is what this activity is designed to do. Through the students' imaginations, rather than their intellects, they will focus on some positive assets of deafness. By giving reality a slight twist, students will gain some insight into themselves in a non-threatening manner.

Ever since you were little children, you have played games in which you made up situations and acted out roles. You may have begun to play by saying — "Let's pretend or make believe that. . . we're movie stars or cowboys." How many of you remember doing this — or maybe still do? Wait for general response.

Well, we're going to pretend something right now. Let's imagine that the world is very different from what it actually is. Imagine that most people in the world cannot hear; that there are only a few who can. You are part of this changed world. Right now you are thinking about your close friend who can hear. You are thinking about the disadvantages this friend has because of his or her ability to hear. Take a few minutes to imagine this, then write your ideas on your paper. Give students some time to focus on this strange idea. **Let's put some of your thoughts on the blackboard.** Write the ideas without comment. Some possible answers are: loud noises are bothersome; it is hard to concentrate when other activities are going on. If students do not suggest these ideas, you might ask, **What about distractions, etc.?** to bring out these ideas.

Part 2

Many students have trouble expressing themselves through words. It is therefore important to use other mediums through which students can be introspective and yet share themselves with classmates. This activity involves drawings, but it is important to explain to the students that they are not expected to be gifted artists. Try to put them at ease, and not to evaluate their artistic abilities.

I want you to think about yourself when you are doing something that you not only enjoy, but also do very well. Wait a minute or so. **Is there anyone who is having difficulty thinking of something?** If anyone is, mention that you will help him or her when the group gets started.

Now think about something that you like doing, but in which you really could use some improvement. Again, give a minute for thinking.

Most of you have a few ideas now. When I give you a piece of paper, fold it in half. Pass out paper. **On the left side of your paper you will draw a picture of you doing what you do well. On the other side, draw a picture of you doing something that you want to do better.**

Be sure to show exactly what you are doing in both pictures. If there are some students who are upset because they "can't draw," tell them that stick people are fine; in fact, anything they can draw is fine, as long as it shows what they are doing.

While students are drawing, move from student to student, giving encouragement and showing interest in their work. When they are finished, sit in a circle and ask each person to share their drawings with the group. Do not "force" anyone to share if they absolutely refuse.

After each student has had a chance to share his or her pictures, you might have students suggest the abilities that were shown in these drawings and list them on the board. For additional abilities, see Game #4 ("How I See My Abilities") of Career Insights and Self-Awareness Games (see Teacher Reference, A-2).

Then the students could suggest a second list, which you will write on the board, of the abilities the students would like to have.

Now, these two lists could be used to generate possible jobs (careers) in which these abilities might be useful.

Optional Activity

Purpose: To give students the opportunity to explore their attitudes regarding women in science related careers.

To give students an opportunity to learn about the accomplishments of significant female scientists.

Even though the role of women in today's society is changing rapidly, your students may still have ambivalent feelings about whether women can have careers in science-related fields. Women already make up more than 50% of the labor force, and yet making the decision to have a career often is a difficult one. This may be especially true for a deaf woman. This activity should give your students a chance to discuss the role(s) of women and the opportunity for science-related careers available to them.

During the activity, you may share with your students how Jean Kelsch Cordano has developed a career as a medical technologist. Deaf since she was four years old, she graduated from Gallaudet in 1951. First she worked in a poultry disease laboratory in Lake Geneva, Wisconsin. Then she went back to school, to the University of Wisconsin, to study advanced medical technology. There she interned at the University Hospital. In 1959, she began work at Lakeland Hospital in Elkhorn, Wisconsin, and became chief of the Medical Technology Department in 1964. She is responsible for the microscopic, chemical, and bacteriological diagnosing and treating of patients' illnesses. The technicians in her lab produce the careful test results which enable doctors to diagnose and cure a patient's disease or injury.

We are going to discuss the question "Can Women Work in Science?" But before we try to answer this question, let me ask you this: How many women do you know who work? and what do they do? Answers will vary. You might like to list the occupations on the board as the students mention them.

Are any of the jobs you mentioned science-related? If yes, try to find out more about the job(s). If not, go right on to the next question.

Remind your students that they were introduced in the filmstrip to three deaf women who have careers in science: Nansie Sharpless, who does research on the brain, and Darcey Slappey and Hershella Hearns who are in computer science. Tell them of the career of Jean Kelsch Cordano.

Do you think Nansie Sharpless, Darcey Slappey, Hershella Hearns, and Jean Kelsch Cordano are the only women ever to have science-related careers? Your students should respond "No" to this question.

If you are a woman and have assets and abilities which might suggest a science-related career, would you be scared to try to develop such a career? Answers will vary. Explore reasons in the discussion.

Would you be the first woman to have a science-related career? No.

Share with your students the following list of female scientists. Either provide a copy of the list, or post it on the bulletin board. (The number at the end of each entry indicates the book(s) listed in Suggested Student Reading where more information may be found.) All of these scientists have made significant contributions to science. They were all born before 1913. For younger scientists, besides those shown on the filmstrip, who might also serve as role models for your students, use references provided in Science Career Exploration for Women (see Teacher Reference).

Female Scientists

Ellen H. Richards (1842-1911) authority on sanitation; one of the first women to receive a degree in science (3)

Annie Jump Cannon (1863-1941) worked at Harvard Observatory; classified 350,000 stars according to Stellar Spectra; deafness in later years proved no handicap to her work (3)

Marie Sklodowska Curie (1867-1934) discovered polonium and radium; first woman to teach at Sorbonne; shared 1903 Nobel Prize in Physics; received 1911 Nobel Prize in Chemistry (1)

Henrietta Swan Leavitt (1868-1921) astronomer at Harvard Observatory; discovered first method of determining vast stellar distances (1)

Alice Hamilton (1869-) American doctor; an authority on illness caused by poisons in industry (3)

Florence Rena Sabin (1871-1953) American anatomist; researched blood vessels, the lymphatic system, and tuberculosis (See Activity B-2) (3)

Mary Engle Pennington (1872-1952) American chemist; authority on refrigeration of perishable foods (See Activity B-2) (3)

Lillian Moller Gilbreth (1878-) American management engineer; helped industry create working conditions for maximum production and maximum worker satisfaction (3)

Libbie Henrietta Hyman (1888-) American zoologist; wrote classic work on invertebrates (3)

Wanda Farr (1895-) American biologist; discovered the origin of cellulose (3)

Ida Eva Tache Noddack (1896-) German chemist; discovered missing element 75 (rhenium) (1)

Hazel K. Stiebeling (1896-) American international food authority (3)

Irene Joliot-Curie (1897-1956) French chemist; daughter of Marie and Pierre Curie; continued their work; shared 1935 Nobel Prize in Chemistry (1)

Florence B. Seibert (1897-) American chemist; worked to control tuberculosis (3)

Katherine Burr Blodgett (1898-) American research physicist; discovered how to make non-reflecting glass (3)

Katherine Esau (1898-) American botanist; specialized in plant viruses (2)

Helen Brooke Taussig (1898-) American physician, pediatrician and cardiologist; helped many cyanotic ("blue") infants and children by increasing blood circulation to lungs (2)

Doris Livesey Reynolds (1899-) English geologist; studied chemical interchanges and migrations in rocks at subvolcanic levels in the earth's crust (2)

Mildred Trotter (1899-) American anatomist; studied variations in anatomical features in humans; used knowledge of skeletons to help identify unknown war casualties in World War II (2)

Margaret Mead (1901-) American anthropologist; studied primitive societies; gained new insights on human behavior (3)

Dame Kathleen Lonsdale (1903-) British X-ray crystallographer; studied structure of carbon atoms (2)

Marie Goeppert-Mayer (1906-) American nuclear physicist; studied nuclear shell structure; shared 1963 Nobel Prize in Physics (1,2)

Dorothy Crowfoot Hodgkin (1910-) British chemist; determined structure of Vitamin B^{12} through use of X-ray crystallography and aid of electronic computer; received 1964 Nobel Prize in Chemistry (1,2)

Chien-Shiung Wu (1912-) American physicist; studied nuclear beta decay and the weak interactions (2)

Teacher References

Egelston-Dodd, Judy. "Overcoming Occupational Stereotypes Regarding Sex and Deafness". American Annals of the Deaf, CXX (October 1977), pp. 489-491.

This article shows that any career development efforts for deaf students should be preceded by some intervention strategies to break down occupational stereotypes which they hold.

James, Edward T. (Ed.) Notable American Women 1607-1950. Cambridge, Mass.: Belknap Press, 1971.

This book gives short biographies of five astronomers, five biologists, sixteen botanists and horticulturalists, five chemists and physicists, and nine naturalists.

National Science Teachers Association
1742 Connecticut Avenue, N.W.
Washington, DC 20009

Order Science Career Exploration for Women by Walter S. Smith and Kala M. Stroup (cost $2.50). This book offers a comprehensive program for helping young women explore science careers. In many ways it parallels the materials in this program for the deaf, treating similar subjects with additional insights relevant to women. It is valuable both as a career guide and also as an excellent reference for additional sources of information about women and science careers, including several sources that provide role models of women working in science careers.

Order Women in Science, six illustrated interviews produced by Dinah L. Moché (cost $27.50). Slide/cassette tape interviews discuss the lives of six contemporary women scientists including an astronomer, a biophysicist, an environmental engineer, a nuclear physicist, an Assistant Secretary for science and technology, and a space life scientist. The taped interviews are not transcribed; however brief written biographies are included. If the filmstrip (Activity A-1) on deaf scientists was particularly effective for your students, you may want to consider using this material too.

Suggested Student Reading

(1) Asimov, Isaac. Isaac Asimov's Biographical Encyclopedia of Science and Technology. New York: Doubleday & Co., 1972.

This book presents factual biographies of scientists, often showing the relationship of one scientist's work to another.

(2) McGraw-Hill. Modern Men of Science. New York: McGraw-Hill Book Company, 1966.

This book gives full biographical data about the scientists it covers and includes portrait drawings of each.

(3) Yost, Edna. American Women of Science. Philadelphia: J. B. Lippincott Co., 1955. (out of print)

The biographies of important women in science careers are easy to read and full of interesting details. They are presented as a narrative.

Activity A-4: A SCIENCE CAREER MAY MEET MY NEEDS

Materials

Magazines
Paste
Scissors
Paper
Activity A-4 transparency

Purpose

To allow each student to examine his or her needs.

Discussion

The two parts of this activity should help students clarify their needs. When making career choices, or just looking at career possibilities, students must consider needs such as the following:

- to be famous
- to contribute to the knowledge about the world
- to solve the problems in the world
- to travel
- to make new discoveries
- to pursue special interests
- to help other people
- to earn a living
- to use special talents
- to use scientific equipment
- to be part of an interesting scientific community
- to teach at a university
- to be challenged
- to be independent
- to gain security
- to do something enjoyable

Through each part of this activity students will have the opportunity, in a non-threatening and enjoyable way, to identify some needs they have right now.

Both parts of this activity are useful, although either or both part(s) will meet the objective of this activity. The collage is time consuming; but because of its hands-on approach, should appeal to students. If you do not have time for both parts, it would be quite possible to use the first part as the major one, and use the voting activity as a warm-up or follow-up to it.

Part 1

Activity

In this activity, students will be making a collage. It is often helpful if the teacher has prepared a personal collage as an example. Remember that in making a collage, the more pictures, the better; let them overlap. Some examples of pictures students might use are: a mother and child (love, security), money or representations of wealth, such as diamonds or cars (financial security), books (knowledge), etc.

Does anyone know what a collage is? For this activity, a collage will be a collection of pictures put together because they all relate to a specific subject. Today we are going to make a collage of those things we need to make or keep us happy. There are lots of magazines from which to choose pictures that express your needs. Let's put some of your ideas of what needs are on the board. Have students respond with their ideas of needs and write each response on the board. Be sure to include such basics as: approval, affection, attention, and acceptance.

It's probably best if you cut out all of your pictures first. Remember to include a variety of needs, but if one need is more important than another to you, you may have more pictures about that one need. Be sure that it is clear to students that someone looking at their collages should be able to know the needs represented. Show yours as an example. **This is my needs collage. Can anyone tell me a need that is shown here?** If no one volunteers, point to a specific picture and help them understand the representation.

If there are no questions, you may begin by looking through magazines. When you've cut out a lot of pictures, I will give you a large piece of paper and paste. Move around the room helping students.

Be sure not to choose pictures for them, but rather help them clarify what need they are trying to represent and the type of picture that may be appropriate. Also, some students may just choose pictures that appeal to them rather than specifically choosing needs pictures. Encourage students to tell what each picture represents, but if they seem frustrated or threatened in any way, allow them to participate in the activity in their own way.

When the students have completed their collages, you may do one of the following:

1. Sit in a circle and have students (if they wish) share their collages with the group. As they explain their collages, allow those who are observing to add any *needs* that they see expressed that the collage creator may have overlooked; however, make sure the observer does not correct the creator.
2. Have students post their collages on the wall and have a "gallery walk" where the students can take time to look at each others' collages.

Part 2

Values voting provides students with an opportunity to tell how they feel about issues, both large and small. It allows them to get in touch with their own feelings while it allows for the expression of the variety of feelings within the group. It is often difficult to explain how or why we think what we do or to express these feelings to a group. This activity does not demand explanation or justification. Because the voting is non-verbal, your students should be able to relax and enjoy expressing their opinions while clarifying some needs they may have.

We all have our own feelings about things, our own answers to questions. But, it is interesting to see how other people think, too. This activity is going to do both of these things. I am going to ask questions of the class. The questions are going to be on many topics. After I ask each question, each person will vote in one of three ways. If you agree or want to answer yes, sign "yes." If you disagree or want to answer no, sign "no." If you are not sure, or want to answer maybe, sign "maybe." If your students do not use signs, you may want to use the following method of voting. **If you agree or want to answer yes, then raise hands high. If you disagree, or want to answer no, then point your thumbs down. If you are not sure, or want to answer maybe, fold your arms across your chest. Now, let's try one just to see if you understand.**

How many of you like ice cream? Remind students of the three ways to vote.

O.K. Now let's try a few more questions. Remember you are not trying to convince any student to alter a vote, but just to vote honestly. (This same list of questions could also be used as a rank order activity.)

How many of you . . .

- **would like to have lots of money?**
- **would like to be famous?**
- **want to go to college?**
- **like animals?**
- **enjoy going to museums?**
- **have a chemistry set?**
- **would like to invent something?**
- **keep accurate records?**
- **take good notes?**
- **like to read science fiction?**
- **like to solve puzzles?**
- **like to build things?**
- **like to draw?**
- **enjoy studying science?**
- **like to take care of plants?**
- **like to visit the zoo?**

How many of you . . . .

- would like to have lots of money?
- would like to be famous?
- want to go to college?
- like animals?
- enjoy going to museums?
- have a chemistry set?
- would like to invent something?
- keep accurate records?
- take good notes?
- like to read science fiction?
- like to solve puzzles?
- like to build things?
- like to draw?
- enjoy studying science?
- like to take care of plants?
- like to visit the zoo?

Activity A-5: SCIENCE IS A GROWTH INDUSTRY

Materials

Masking tape
Felt-tip marker

Purpose

To explore students' attitudes towards science, scientists, and science careers.

Discussion

The attitude of students toward science will be a very important factor in their consideration of science as a possible career. Many young people today have ambivalent feelings about science and the work of the scientist. They feel that science is destructive and opposed to human values. For example, scientists have created food additives which may cause cancer. Also, research is beginning to show that deaf youngsters seem to have additional negative feelings because they equate scientists with the doctors who have poked and prodded at them since they were infants, but who have not cured their deafness. Therefore, any attempt to develop an interest in science careers must include an effort to point out the positive contributions which science makes to our daily lives.

Remember, however, that the main purpose of this activity is to explore the students' existing attitudes. This means that it is important for you not to reject or "put down" a student's response. The students should feel that what they think is important. You should create a non-threatening atmosphere that encourages the students to be honest and open about their attitudes.

During the two parts of this activity, you may try to clarify the attitudes that are expressed by focusing on possible biases brought out through the experiences mentioned above.

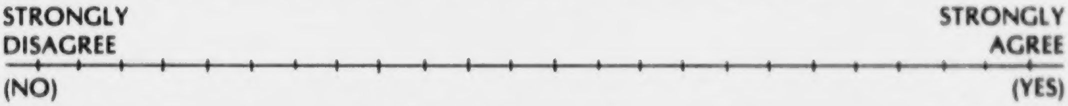
The optional activity addresses students' attitudes toward science as influenced by their perception of the employment opportunities expected in science-related occupations.

Most students do not have a good idea of how science careers relate to the overall employment picture in the United States and this further serves to create negative feelings. Some students know that many scientists have been laid off following changes in the U.S. space program. This activity may help them develop an understanding of the critical roles of people in science in our society.

Part 1 **Activity**

This activity uses the concept of a continuum, although it doesn't matter if the actual word continuum is used. Place a line of masking tape along the blackboard, a wall, or on the floor. Label one end "Strongly Agree" and the opposite end, "Strongly Disagree."

Sometimes, when we are asked a question, we realize that the answer is not a simple yes or no, black or white, yet we do feel more yes than no. We can express these degrees of feelings by placing one opinion along a line (called a continuum). Show a continuum on the blackboard.



This is what a line (continuum) might look like. If I wanted to react to a statement such as, "Education is important," I would place myself all the way to the right side by "strongly agree." Draw a little stick figure at that place.

STRONGLY
DISAGREE
STRONGLY
AGREE

We're going to try to do this a little differently. Notice the labels and masking tape along the wall, blackboard, or floor. Where would I stand along this line to demonstrate how I feel about the education statement? Students probably will indicate the far right side — strongly agree.

Now, let's try a "yes" statement. "I wish my school had more science courses." Think about your opinion and then come up and stand at the appropriate place on the line (continuum). You may have to encourage students to begin this. Choose a more outgoing student to be first and usually the others will follow.

- I like nature hikes.
- I enjoy discovering new things.
- I generally have good ideas.
- Deafness should not stop a person from following a career in science.
- I think it's fun to do science things in my spare time.
- If I had my choice, I would never take a science course.
- Knowing things in science is helpful in everyday living.
- Workers in science careers almost always work by themselves.
- Scientists don't care about problems in the world.
- Science is important.

Part 2

Priorities affect most of our decision making. Rank ordering is a procedure that helps explore some possible alternatives and attitudes regarding value-laden issues.

I am going to read some questions to you, and I am also going to read some possible responses. The difference between this activity and tests that you may have taken is that there is no right response. Think about which response is best for you, then which is the second best, then which is the one that is least appealing to you. We will use a number 1 for the best answer, then the number 2, and finally the number 3 for the least appealing response. You may still like your third choice, but not as much as the first and second. You may want to write the options on the blackboard as you proceed.

Write the following words in a list on the blackboard: CAKE, ICE CREAM, PIE. Put a #1 in front of the item that you like best. Put a #2 in front of the item that you like second best. Put a #3 in front of the remaining item. Describe to the students your selections.

Let's try one together. What do you like to do best?

____ PLAY GAMES

____ READ A BOOK

____ PLAY OUTSIDE

Who would like to answer this question? Choose a student. Be sure he or she gives each response in priority order. For example: A student might say that playing outside is #1, reading is #2, and #3 is playing games. Do not accept an answer such as 3, 2, 1. Also be careful not to judge the rank order, or to make students justify their answers; just accept it and ask for another volunteer. **"O.K. John; thank you. Mary, would you share your order with us?"** Ask a few opinions to clarify answers, then go on to the next question.

- **Where would you rather be on a Saturday afternoon?**
  ____ AT THE BEACH
  ____ IN THE WOODS
  ____ IN A DEPARTMENT STORE

- **Who is needed most in society? the world?**
  ____ A SCIENTIST
  ____ A POLICE OFFICER
  ____ AN ACTOR/ACTRESS

- **If you were President, which would you work on first, second, and third?**
  ____ EDUCATION
  ____ POLLUTION
  ____ HOUSING

- **Which do you like best?**
  _____ SOCIAL STUDIES
  _____ MATH
  _____ SCIENCE
  _____ ENGLISH

- **Where would you most like to go?**
  _____ TO THE ZOO
  _____ TO THE LIBRARY
  _____ TO THE SCIENCE MUSEUM
  _____ TO THE MOVIES

- **Who would you most want as a neighbor?**
  _____ A TEACHER
  _____ A CIRCUS CLOWN
  _____ A SCIENTIST

- **What is most important in a job?**
  _____ HIGH SALARY
  _____ YOUR JOB TITLE
  _____ ENJOYING YOUR WORK

- **How do you most enjoy learning?**
  _____ ALONE
  _____ IN A SMALL GROUP
  _____ ALONE WITH A TEACHER

- **For which would you most like to be famous?**
  _____ INVENTING SOMETHING
  _____ WRITING A GREAT BOOK
  _____ BEING AN ACCOMPLISHED ACTOR/ACTRESS

For additional examples and insights into this kind of an activity, use Clarifying Work Values (see Teacher Reference).

Optional Activity

Purpose: To explore student attitudes regarding science and/or the availability of jobs in science.

If in doing these activities you detect negative attitudes about science or the availability of science jobs, discuss these attitudes with your students. Work either with the whole group or with just those individuals who express the negative feelings. Be careful to let the students discuss their ideas before you present them with information. Sometimes information before a discussion sways students to think there is a right or wrong answer.

The following information may help you. If students express negative feelings about science, recognize their concerns and point out some positive considerations. For example, they might argue that because cars are dangerous, they pollute, and they waste energy resources, any scientific effort to develop cars further will continue to have a negative impact on society. You could argue that a great deal of research is being carried out to make cars less dangerous (seat belts, air bags, safer tires, etc.), to cut pollution (anti-pollution devices, special fuel), and to conserve energy resources (improved gasoline mileage).

Furthermore, the impact cars have made on our way of life in terms of convenience, ability to live at a distance from one's place of work, etc., could be pointed out. The important aspect of this kind of discussion is to explore both the positive and negative sides of an issue so that attitudes can be formed on an informed and rational rather than a strictly emotional basis.

If students express concern over the availability of science jobs, the following information may be helpful.

About 2.5 million people or nearly one-quarter of all professional workers were engineers, scientists, or other technical workers in 1974.

Employment in these occupations increased much more rapidly than did total employment over the past 25 years; the number of scientists and engineers, for example, almost tripled, while the total number of workers in the United States grew by less than half.

The growth of our scientific and technical work force resulted from many factors, including overall economic growth; increased research and development (R&D) expenditures; growth of college and university faculties; the race to put a person on the moon; and the development of sophisticated defense systems. Many technological innovations, such as the widespread use of computers, also contributed to this growth.

Opportunities in scientific and technical occupations are expected to expand through the mid-1980s, based on the assumption that additional numbers of engineers, scientists, and technicians will be needed to carry out research and development (R&D) work. In the past, growth in these occupations has been related to increased R&D expenditures, especially by the federal government. R&D expenditures by the government and industry are expected to continue to increase through the mid-1980s, although more slowly than during the 1960s. If actual R&D levels and patterns differ significantly from those assumed, the outlook in many occupations would be altered.

Scientists, engineers, and other scientific and technical workers will be needed to develop new technologies and better products. In addition, many technically trained people will be required to solve urgent problems such as air, water, and noise pollution, to develop new sources of energy, and to combat disease.

Employment of programmers and systems analysts is expected to grow faster than the average for all occupations through the mid-1980s as computer usage expands, particularly in medical, educational, and data processing services. In addition to opportunities that will result from growth, some openings will occur as systems analysts advance to managerial positions or enter other occupations. Because many of these workers are relatively young, few openings will result from retirement or death.

The demand for systems analysts is expected to increase as users become more familiar with computer capabilities and expect greater efficiency and performance from their data processing systems. Advances in hardware and computer programs will result in expanded computer applications in manufacturing and small businesses, and this, too, will contribute to employment growth.

Notes and Comments

Part of this activity discusses the availability of science jobs. One of the fastest growing science occupations is computer science. As computer technology continues to expand, so do the job opportunities in this area. Mentioned here are four deaf people who have successfully established themselves in computer science careers.

Philip W. Bravin has worked for International Business Machines Corporation since 1968. His current job is to help customers identify and analyze various aspects of their data processing problems and to define and implement solutions. Bravin has had extensive experience with a number of different computers and programming languages and systems. Bravin has been profoundly deaf since birth. A graduate (1966) of Gallaudet College, Bravin majored in Business Administration and minored in Computer Science. He has continued his education with post graduate courses in mathematics, economics, accounting, and computer science at the University of Hartford and Union College.

Selina Gilson is a mathematician working in computer science, employed at the David W. Taylor Naval Ship Research and Development Center in Bethesda, Maryland. She works in the Structures Department and is a graduate of Gallaudet College.

Joseph S. Slotnick joined the System Development Corporation in Santa Monica, California in 1959. His skill in systems programming has contributed to major projects concerned with missile defense and the Strategic Air Command. Slotnick became deaf at age 3. An honors graduate from high school, he continued his education at Harvard University where he studied physical science. Upon graduation in 1955, he spent four years in technical employment before moving to the System Development Corporation.

Donald H. Stoops works for the Data Processing Department of the Kane County (Illinois) Government Center. He works on systems for real estate taxes, capital expenditures, animal control, etc., using the computer language training in COBOL, RPG, and Systems Design which he received at the National Technical

Institute for the Deaf (NTID) at Rochester Institute of Technology. In the initial phases of a project, Stoops interacts closely with people to define the problem and its solutions. Then he independently implements the solution, from flow charts to final application. Stoops, who has an Associate Degree in Data Processing (1972) from NTID, spends his free time reading about new computer procedures, applications, and equipment.

Teacher Reference

Occupational Outlook Handbook, 1976-77 Edition. U.S. Department of Labor, 1976. Bulletin 1875.

This book gives detailed information about many different careers. It describes what is done in various careers, their educational requirements and their employment outlook. It costs $7.00. Reprints focusing on specific careers are available: Conservation Occupations ($.25), Engineers ($.30), Environmental Scientists ($.30), Life Science Occupations ($.25), Mathematic Occupations ($.25), Physical Scientists ($.30), Technician Occupations ($.30), and Social Scientists ($.30). The handbook or reprints can be purchased from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402 or from one of the regional offices.

1603 Federal Office Building
Boston, MA 02203

230 South Dearborn St.
Chicago, IL 60604

1515 Broadway
New York, NY 10036

911 Walnut Street
Kansas City, MO 64106

P.O. Box 13309
Philadelphia, PA 19101

1100 Commerce St. Rm. 687
Dallas, TX 75202

1371 Peachtree St. NE.
Atlanta, GA 30309

450 Golden Gate Ave.
San Francisco, CA 94102

Muson, Harold L., and Judy C. Egelston. Clarifying Work Values: Strategies for Career Education, Experimental edition. Rochester, N.Y.: University of Rochester, 1974.

This booklet has excellent strategy lessons for clarifying values built around work habits, the conditions of work, worker motivation and satisfaction, and the economics of work. It was written for the Career Development in the Education of the Deaf project (CREED).

Raths, Louis E., M. Harmin, and S. B. Simon. Values and Teaching. Columbus, Ohio: Charles E. Merrill, 1966.

The authors stress the importance of clarifying values in the classroom.

Simon, S. B. and H. Kirschenbaum. Values Clarification: A Handbook of Practical Strategies. New York, N.Y.: Hart, 1972.

The authors describe a method of defining, understanding, and acting upon personal values.

BEST COPY AVAILABLE

Activity A-6: SCIENTIFIC WORK IS IMPORTANT

Materials

Copies of Activity A-6 Handout
Drawing paper for Optional Activity

Purpose

To give students an opportunity to speculate or imagine about how science will change the way we will live in the future.

Discussion

As individuals working in science unlock the "secrets" of the natural world, those in technology use the information to make new products that change the way we live. Science changes the way we live and touches upon many things in our lives, from automobiles to toothpaste. Those individuals working in space technology have added many products which we have come to take for granted: light-weight "space" blankets, freeze-dried food, telephone-linked heart monitors, and Teflon, to name just a few. This activity will help your students become aware of how individuals working in science have changed our lives.

It should be noted that some students may have difficulty with the final step in this activity (drawing a futuristic kitchen) since the concept of "future" may be difficult for many youngsters to grasp. Furthermore, because schooling for the deaf has traditionally emphasized language development and the acquisition of information and vocabulary, there is usually little time devoted to imaginative and projective thinking. Therefore, although this activity may require some extra encouragement and support, it should be looked upon as an opportunity to develop some important, but often neglected skills.

Activity

In this activity we are going to discuss how some things have changed. For instance, before there were cars, how did people get around? They biked, walked. They rode horses. They went in horse-drawn carriages or wagons.

Here's another question: Before there were airplanes, how would you have taken a long trip? By boat, by stagecoach, by train, by bus, by Conestoga wagon.

Let's try one more. Before there were hand-held calculators, how did people do all their arithmetic? With desk calculators or with paper and pencil.

So we might say, "Things change." Who do you think helps to make the changes? People working in science are largely responsible for bringing about change.

I am going to give you a handout. Pass out copies of the handout. **At the top you will see two pictures. One shows a kitchen from a long time ago. The other shows a kitchen of today which you might see in a magazine or on television.** Some of your students may not have such a kitchen in their home, so use the magazine reference instead of giving your students the impression that every home should have such a modern kitchen as the one shown.

Look at the picture in the top left corner. The picture is labeled "1900." What things do you see in this picture? Students should mention such things as the gas lamp, the old-fashioned stove, the dishes drying on the counter, the dishpan, etc. The emphasis should be on the way things were done in a kitchen in the year 1900.

Write the following words on the blackboard: ELECTRIC LIGHTS, MICROWAVE OVEN, REFRIGERATOR, and DISHWASHER.

Would any of these things be in a kitchen in 1900? No! **Look at the picture in the top right corner of the handout. Can you find these things in the picture at the top right corner?** Yes.

Look at the four sentences at the bottom right corner of the handout. Fill in the blanks by using the words on the blackboard. Check the answers as the students finish. The answers are: 1. refrigerator, 2. dishwasher, 3. electric lights, 4. microwave oven.

Who helped invent each of the things you wrote? Scientists and engineers.

How has the refrigerator changed the way people live? It keeps food cold so that it does not spoil. People do not have to shop every day for food. Refrigerated trucks and railroad cars allow foods to be shipped long distances to stores. An additional example that your students might enjoy is ice cream that can now be kept in a home freezer — before, it was made and eaten right away.

How has the dishwasher changed the way many people live? It improves the sanitation of kitchen utensils and dinnerware. It speeds clean-up after each meal.

How have electric lights changed the way we live? At night we have steady, unflickering light so we can see without straining our eyes. Lighted streets and walkways provide greater safety than before.

How has the microwave oven changed the way some people live? Microwave ovens can cook foods much more rapidly than gas or electric ovens. Microwaves pass through glass, paper, and china so foods can be cooked in containers made of these materials. This method has helped the increase of "fast food" restaurants.

Do you think these improvements (refrigerator, dishwasher, electric lights, microwave oven) are good? This is a value-laden question, so answers will vary. Some students might consider a dishwasher or a microwave oven a luxury. Others might be concerned about the extra consumption of energy required by these appliances. Some might question the health safety of microwave ovens. You might want to point out that people in science-related careers have the job of trying to solve such problems.

What do you think a kitchen might look like in the year 2050? Answers should vary. Stimulate brainstorming by writing answers on the blackboard.

Look at the box labeled 2050. Draw your ideas in the space provided. Share the drawings when they are done.

Optional Activity

Purpose: To provide an opportunity for students to fantasize and think of an invention.

Think of some jobs that you do not like to do. Write them down on the back of the handout. You have five minutes to think of as many as you can.

Give students five minutes to write down ideas.

From your list, circle the worst job. Now, think of a machine that could help you do that terrible job. Draw a picture of your invention. Your students may need more paper as the back of the handout might be filled with writing.

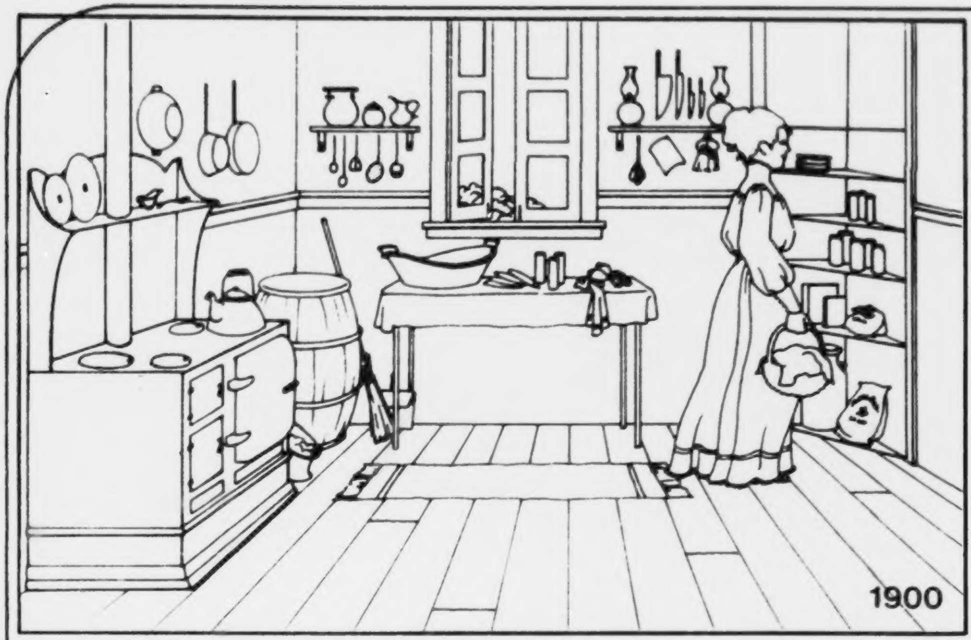
Give students ample time to draw their inventions. Hang the pictures up. Give students a chance to walk around to see all the drawings.

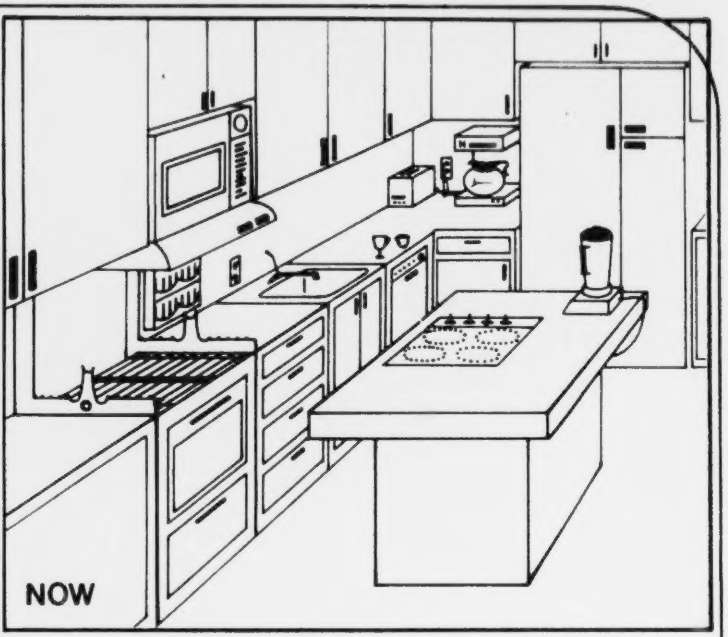
Let's discuss your inventions. If students want to discuss the inventions, find out what the invention does and how it could be made. If some students are embarrassed or feel hesitant to discuss it, don't force them to explain their drawings.

Teacher References

World Future Society
4916 St. Elmo Avenue (Bethesda)
Washington, DC 20014

The objectives of this society are to contribute to a reasoned awareness of the future, to investigate the future, and to increase public awareness about the future. The society publishes a bi-monthly journal of forecasts, trends, and ideas about the future.





2050

Directions: *Use these words to complete the sentences below.* **(microwave oven, refrigerator, dishwasher, electric lights)**

Then draw a kitchen as it might look in the year 2050 in the space to the left.

1. Today, we keep meat in a ______________________.
2. Today, we wash dishes in a ______________________.
3. Today, we light up a room with ______________________.
4. Today, we can cook foods quickly in a ______________________.

ACTIVITY A-6

Activity A-7: THE RESULTS OF SCIENTIFIC WORK CHANGE OUR LIVES: ONE EXAMPLE

Materials	Purpose
Activity A-7 Transparency	To explore automobile technology as an example of the way workers in science and engineering have changed our lives.

Discussion

Often it is easier to make a point through a concrete example than it is to talk about something in the abstract. So, instead of telling your students, "The people in science change our lives," this activity will give them an opportunity to explore the impact that scientific and technological findings have had on the automobile industry.

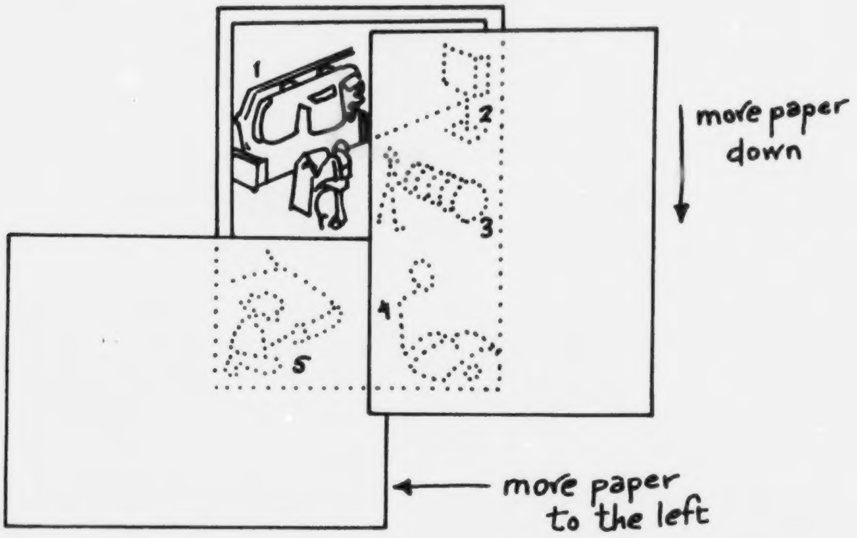
Back in 1792, Oliver filed for the first "Motor Car" patent in America. But, the motor car industry in America did not develop as we know it today until Henry Ford, one hundred years later, refined the automotive assembly line. Over the years, cars have changed dramatically.

Today, scientists and engineers constantly try to find ways of improving automobiles. They look for ways of making cleaner burning engines, safer bumpers, more economical fuel consumption, longer-lasting tires, etc. Often an entire car is dismantled after it has been tested to check each piece for wear.

After your students do this activity, they should have a new awareness of how those individuals working in science careers change our world. They should be able to recognize that science is the basis of most of those things that we take for granted.

Activity

Show the transparency. It may be helpful to use a masking technique to show each of the transparency drawings one at a time. The drawings are presented in a clockwise fashion, beginning in the upper left corner. By placing two sheets of paper over the transparency as shown by this diagram, you can show the drawings in the proper sequence.



This activity is about cars. Is a car tested before it is made in large numbers? Yes. Manufacturers put cars through many tests before they are mass produced. These tests include: road tests in which cars are driven in many different road conditions; equipment test of shock absorbers, springs, seat cushions; new equipment tests of air bags.

Let's look at picture number 1. The car in this picture has had an experimental accident (impact), and the technician is now checking to see if the gas system has been damaged.

The scientist in picture 2 is testing a synthetic oil. The gasoline shortage has made scientists try to think of new ways to fuel a car. What do you think scientists are doing to stop the gasoline shortage? They are developing electric cars. They are also developing synthetic products such as synthetic oils.

Cars are made of many different kinds of materials, such as metal, glass, plastic, rubber, etc. Each material must be especially suitable for the job it does. How can scientists make the metal in a car strong, yet light? Research physicists and engineers study metals to find the metal mixtures (alloys) that will be best for cars. They use microscopes to analyze the metals.

How are rubber tires made safe? Scientsts and engineers design special treads that prevent skidding. They also develop ways of adding steel to the tires to make them stronger. **The technician in picture 3 is testing tires for wear.**

How can scientists make glass suitable for cars? They devise ways to make it shatterproof. Also, glass is often tinted to reduce the glare of bright sunlight.

Today, engineers are trying to design car bodies and motors to be lighter weight and have less wind resistance. The engineer in picture 4 is demonstrating his new ideas.

But safety is also very important. Look at the scientist in picture 5. She is checking on a new bumper design for cars.

It is obvious from this activity that scientists are trying hard to make the automobile better in every way they can. They have really changed from the first cars that were built at the beginning of the twentieth century.

List some changes on the board. **What do you think of all these changes?** Answers will vary. Try to make the discussion bring out the pros and cons of automobiles. Perhaps writing PRO and CON on the blackboard and asking your students to think in those terms might help the discussion.

Below are some of the arguments that your students may think of:

PRO
greater comfort
greater safety
greater choice in where people
  live as they can travel large
  distances to where they work
greater mobility

CON
land taken up with roads
accidents
gas and fuel consumption
pollution
cost

How do you judge the products of scientific technology? Are they good or bad? Answers will vary. The importance of asking this question is to provide you with an additional opportunity to get an idea of how your students view science.

Optional Activity

Purpose: To provide students with an opportunity to explore ways science helps to improve everyday products.

We have just discussed how people in science-related careers help to improve cars. Do you think all people in science-related careers work with cars? No.

People in science-related careers can work on many different projects. I am going to write three common things on the board. Write EYEGLASSES, PIZZA, BLUE JEANS.

Can you think of ways people working in science might improve these products?

Eyeglasses - Benjamin Franklin used half-lens reading glasses, and today millions of people with less than 20-20 vision use glasses. In recent years there have been many improvements in eyeglasses. The glass in lenses can be made shatterproof, and also the glass can be tinted to make sunglasses. Some glasses can actually change according to the amount of light that hits them, thus effectively becoming sunglasses outside and clear glasses inside.

Pizza - The people who make pizzas in pizza parlors probably would not call themselves scientists. However, once pizza is packaged to be sold in the frozen food section of supermarkets, people who are trained in science play an important part in the production and packaging of pizzas. For example, the nutritional value of the pizza must be analyzed, and additives must be introduced to retard spoilage.

Blue Jeans - Since Americans have started wearing blue jeans for fashion, the blue jean industry has developed very rapidly. People in science have worked to develop special fabrics and dyes. Not all blue jeans are made of strong cotton denim. Many are made to be wrinkle-free, or color fast, and to have controlled shrinkage.

As you can see, all the improvements mentioned require someone with knowledge in science.

Now let's try to think of a few more common products. Take time to write them on the board. How do people working in science help to improve or work with these products? Answers will vary.

Notes and Comments

A deaf chemist, George T. Dougherty, made a significant contribution to the making of steel and thus to the automobile industry. He published a paper in 1915 outlining his methods of determining the vanadium content in steel, an important element in making steel stronger and lighter.

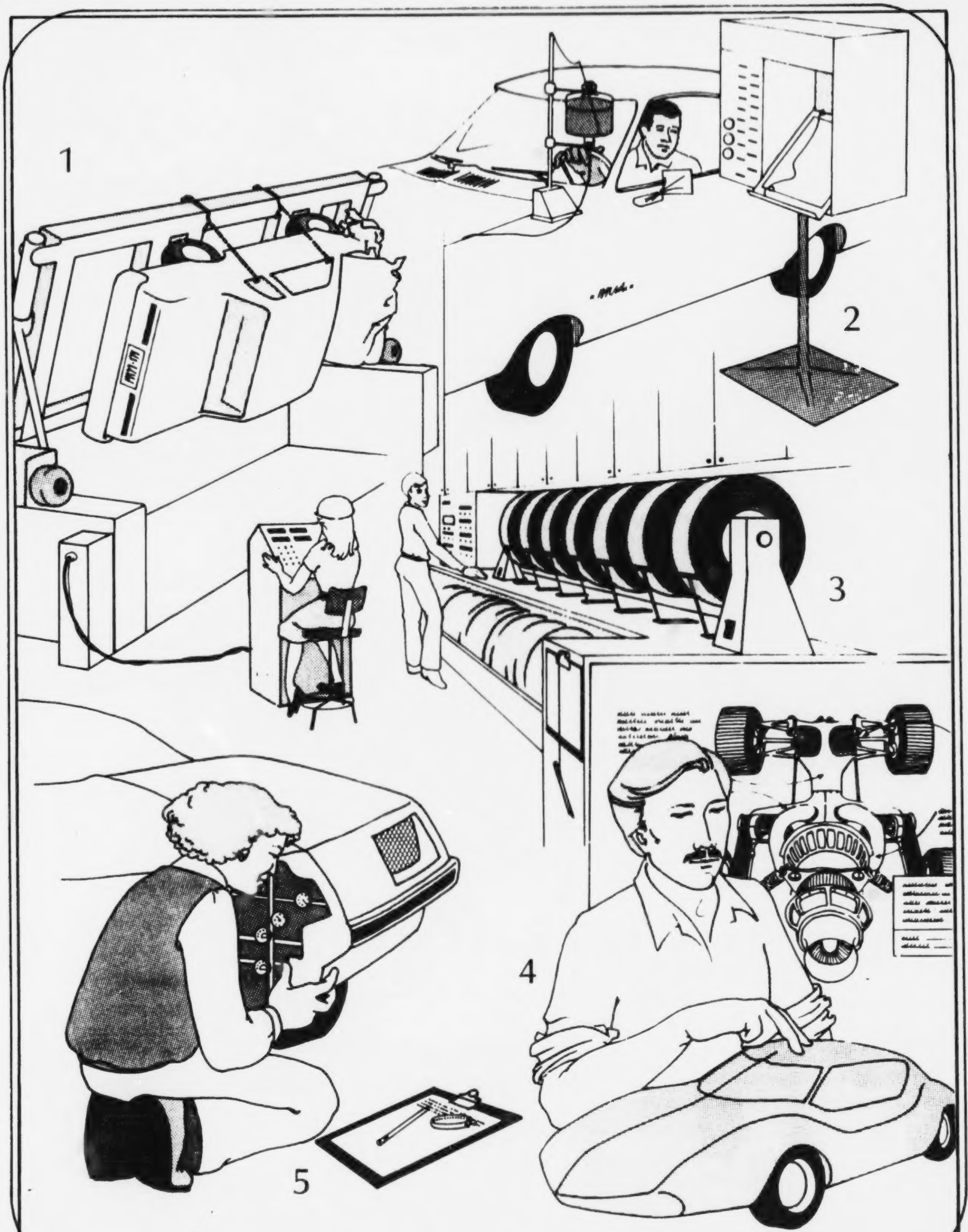
Teacher Reference

Educational Affairs Information Center
Ford Motor Company
B-49 American Road
Detroit, MI 48121

Ford Motor Company will send informative reports on such topics as alternative power sources, EPS and fuel economy, automobile emission controls, and the evolution of mass production.

Motor Vehicle Manufacturers Association of the United States, Inc.
300 New Center Building
Detroit, MI 48202
Attn: Manager, Educational Programs

This association will send several informative booklets which discuss what it takes to make a car, the importance of the trucking and busing industries, the national scope of the motor vehicle industry and facts and figures of the automotive industry.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2
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5

General Motors Corporation
Public Relations Staff
Room 1-101
General Motors Building
Detroit, MI 48202

Ask for the catalog, Aid to Educators which gives a detailed listing of material available to schools. More specifically, GM has four booklets on guidance which may be of great value: "Can I Be A Draftsman?" (sic), "Can I Get The Jobs?", "Can I Be A Technician?", and "General Motors Institute."

Suggested Student Reading

Butler, Hal. Millions of Cars: From Drawing Board to Highway. New York: Julian Messner, 1972.

This text, written at a fourth to sixth grade reading level, describes careers related to the auto industry by following the production of a single model, from design through assembly line to publicity.

Activity B-1: PEOPLE IN SCIENCE WORK ON MANY TOPICS

Materials

Activity B-1 Transparency

Purpose

To explore the various areas (disciplines) of science.

Discussion

What are the areas in which people in science careers work? That question is hard to answer because there is such a tremendous diversity in science. To indicate this diversity, this activity focuses on the following major areas: computer science, conservation, engineering, environmental sciences, life sciences, mathematics, medical technology, physical sciences, and other scientific and technical areas (see Transparency).

This activity is designed to explore with your students a number of specialties within each of these major areas. There is no need for students to memorize either the areas or the specialties. What is important is that they become aware that diversity does exist. During the discussion try to use values clarification questions; for example: In which area would you like to work? Why do you think a certain area is important? Would your assets and abilities enable you to work in these areas? Do you know anyone who works in one of these specialties? These questions have not been incorporated into the activity; however, they will help students relate to the different areas of science. Use them wherever they seem appropriate.

The main activity presents information to be used as an introduction, going over the material fairly rapidly. Discuss each specialty shown in the right hand column of the transparency in a way appropriate to the experience of your students. Then concentrate your time and effort in one or more of the optional activities, depending on the interest and abilities of your students.

Activity

What do you think people in science do? In the broadest terms those working in science observe, study, and experiment to learn about the physical world.

Do all those in science study the same things? No.

Can you think of some different areas of science? Answers will vary. Try to elicit as much information as the students might have. For example, they might be familiar with biology, chemistry, physics, etc.

I am going to show you a transparency that lists several areas of science. We will discuss each area to get an idea of some different science jobs. Show the transparency. The science areas shown are based on some of the careers discussed in the 1976-77 edition of the Occupational Outlook Handbook, published by the U.S. Department of Labor (see Teacher Reference, Activity A-5). When you show the transparency, block out the right hand column. Reveal it only as you discuss each area. The objective in discussing each area is for the students to get an idea of the great number of different science careers. They do not need to know the names or specifics about each career.

Here are some of the jobs in computer science. Show the list in the right hand column for computer and related occupations. Computers will probably change our lives more dramatically than any other technological advance in the twentieth century. Home computers will become commonplace; and business and industry will use computer technology to save time, run more efficient operations and, in fact, do things unable to be done without computers. Grocery stores will have computer check-out systems (some already do); industries, such as the automotive industry, will use graphic display computer systems to help in the design process; the telephone system will use computers to turn telephones into burglar and fire alarms; hospitals will use computers in every area of patient care.

Here are some of the jobs in conservation. Show the list in the right hand column. *Conservationists* must have an interest in the environment and a desire to protect it. A conservationist might work in a remote camping area one week, speak to a community group the next, and fight a forest or brush fire the next.

Here are some of the jobs in engineering. Show the list. *Engineers* play a prominent role in bringing scientific progress into our everyday lives. They convert raw materials into useful products by applying basic scientific principles. For example, an agricultural engineer will know how to get maximum crop production from a piece of land by using principles of fertilization, crop rotation, etc. Or a petroleum engineer will know how to refine crude oil to get the maximum amount of useable oil. Most engineers work in private industry, primarily in industries manufacturing machinery, electrical equipment, and aircraft, and in firms providing engineering and architectural services. Engineers usually specialize in one of several branches. *Electrical* and *mechanical engineering* are the largest branches. Engineers work in the production departments of manufacturing firms, sell technical products, provide technical assistance to customers, and design, develop, and test equipment. Some work in supervisory and management jobs in which knowledge of engineering is required.

Here are some of the jobs in environmental science. Show the list. *Environmental scientists* study the earth, its oceans, and its atmosphere. Their work results in an increased understanding of our planet and is important in controlling pollution, discovering and developing natural resources, and predicting weather. This group includes *geologists*, *geophysicists*, *meteorologists*, and *oceanographers*. The specialty employing the most people in this group is geology. Most geologists work in petroleum extraction industries and in colleges and universities, teaching and doing research.

Here are some of the jobs in life science. Show the list. *Life scientists* study life processes and living organisms, from the largest animals to the smallest microbes. The majority teach or do research in colleges and universities. *Biological scientists* are the largest group of life scientists. *Medical science* has been the fastest growing group over the past two decades.

Here are some of the jobs in mathematics. Show the list. Some *mathematicians* spend all their time on theoretical research, while others apply mathematical principles to practical problems. Both mathematicians and statisticians work to solve problems in science, management, and engineering. *Statisticians* design experiments, collect, analyze, and interpret the numerical results of surveys, quality control tests, or economic and business research programs. In doing so, they assist managers and administrators in making decisions.

Here are some of the jobs in medical technology. Show the list. These jobs all support the health care system. People in these jobs maintain and interpret medical records. They take blood pressure or X-rays of patients to help doctors decide how to treat patients' illnesses.

Here are some of the jobs in physical science. Show the list. *Astronomers* study matter in outer space. *Chemists* study the structure of substances and the reactions by which substances are produced from or converted into other substances. *Food scientists* study different foods, their production, and their role in nutrition. *Physicists* study matter and energy. There are solid-state, nuclear, optical, elementary-particle, atomic, molecular, electron, fluid, plasma, space, planetary, and acoustical physicists, to name a few specialties of physics. People in the physical sciences contribute to the basic understanding of the structure of the natural world.

Here are some other scientific and technical occupations. Show the list. There are many different jobs that could be described in this section. More than 900,000 workers in *other scientific and technical occupations* assist scientists and engineers. These jobs range from anthropologists and archeologists to drafters, engineering and science technicians, and surveyors. *Anthropologists* study primitive tribes, reconstruct civilizations of the past, and analyze the physical characteristics, cultures and languages of all people, past and present. *Archeologists* are a specialized group of anthropologists who study civilizations, people, and language of the past. *Drafters* prepare detailed drawings which show dimensions, material requirements, and other specifications for engineers, architects, and designers. *Engineering and science technician* jobs are more practical and limited in

AREAS OF SCIENCE

COMPUTER SCIENCE	Computer operating personnel
	Programmers
	Systems analysts
CONSERVATION	Foresters
	Forestry technicians
	Range managers
	Soil conservationists
ENGINEERING	Aerospace engineers
	Agricultural engineers
	Biomedical engineers
	Ceramic engineers
	Chemical engineers
	Civil engineers
	Electrical engineers
	Industrial engineers
	Mechanical engineers
	Metallurgical engineers
	Mining engineers
	Petroleum engineers
ENVIRONMENTAL SCIENCE	Geologists
	Geophysicists
	Meteorologists
	Oceanographers
LIFE SCIENCE	Biochemists
	Life scientists
	Soil scientists
MATHEMATICS	Mathematicians
	Statisticians
MEDICAL TECHNOLOGY	Medical laboratory workers
PHYSICAL SCIENTISTS	Astronomers
	Chemists
	Food scientists
	Physicists
OTHER SCIENTIFIC AND TECHNICAL OCCUPATIONS	Anthropologist
	Archeologist
	Drafters
	Engineering and science technicians
	Surveyors

scope than those of engineers and scientists. The more highly skilled technicians, however, analyze and solve engineering and science problems and prepare reports on tests and experiments. Technicians in research and development set up complex laboratory equipment and help design scientific instruments. They help test products in production and act as liaison between engineering and production departments. Others sell technical products, install complex equipment, and provide technical services to customers. *Surveyors* measure construction sites, establish official land boundaries, assist in setting land valuations, and collect information for maps and charts.

Optional Activity 1

Purpose: To discuss six different science careers in different areas of science.

We have discussed a great many different science careers in this activity. Now we will discuss just six different science careers. I am going to show you a transparency (Activity B-1 optional Transparency) **with pictures showing people working in science careers. For each picture we will discuss what the person does, and we will try to think of some reasons why the job is important both to the person and to society.** For each example, discuss the picture and the text:

- What is the person doing?
- What does the text mean?
- Why might the job be important to the person doing it?

Look at the picture and text about the agronomist (ə–gron′ ə-məst). Discuss the picture and the text. This person may have become an agronomist because of interest in agriculture, concern with world hunger, desire to be outdoors, interest in genetics, experience in gardening, etc. Agronomists help us get the best crop production from our valuable farm lands. They will be critical in solving the world's food problems in the future.

Look at the picture of the civil engineers (siv′-l en′ jə-ni(ə)rs). Discuss the picture and the text. These people may have become engineers because of interest and skill in mathematics, interest in putting things together to find relationships, interest in structures, etc. Civil engineers are responsible for designing structures that are safe. Often they must solve new problems such as how to bridge wide rivers, e.g., Verrezano Narrows Bridge in New York.

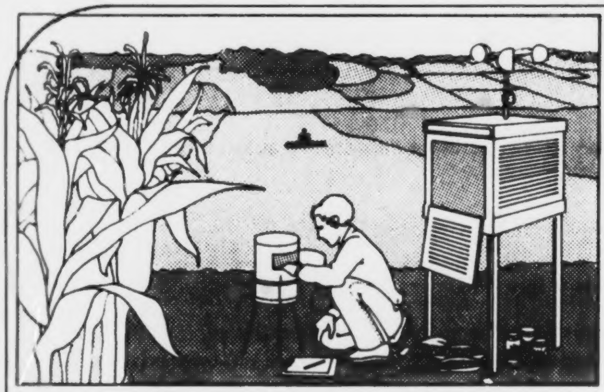
Look at the picture of the herpetologist (hur′ pi-tol′ ə-jəst). Discuss the picture and the text. Although there are not many herpetologists, this career is included here for its special interest. This person may have become a herpetologist because of interest in collecting animals, ability in handling snakes, curiosity about how reptiles live, love for the zoo, etc. Herpetologists might work in zoos or research laboratories. They might be collectors interested in the classification of reptiles. They might be interested in studying the poisons of snakes for pharmaceutical reasons.

Look at the picture of the electronics technicians. Discuss the picture and text. Notice the small size of the parts these people are working with. This work requires great manual dexterity. Also notice that the people are wearing glasses for protection. Excellent eyesight is a requirement of assembly jobs in the electronics industry. Because the electronics industry is responsible for making computers, among many other things, it will be one of the most important industries for modern society.

If students notice the leg brace on the woman in picture 4, tell them that some people must wear a leg brace throughout childhood or even throughout life. Handicaps, whether temporary or permanent, are part of normal existence.

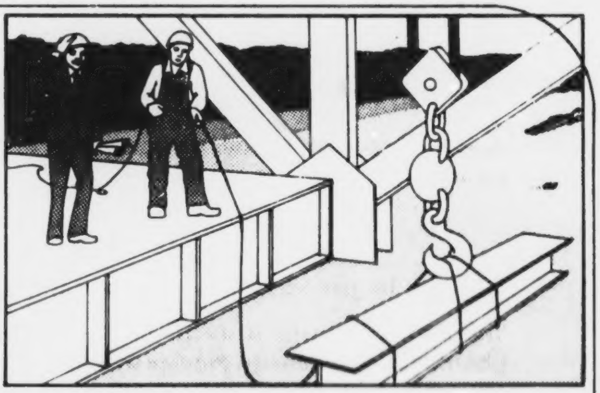
Look at the picture of the demographer (di-mog′ ra-fer). Discuss the picture and the text. This person might have become a demographer because of interest in data about people, desire to improve the world, liking for long-range projects, good background in mathematics, etc. Demographers work in long-range planning. They know how populations grow and try to predict future needs such as for food, transportation, etc.

Look at the picture of the astronomer (ə-stron′ə-mẽr). Discuss the picture and the text. These people might have become astronomers because of curiosity about outer space, strong abilities in



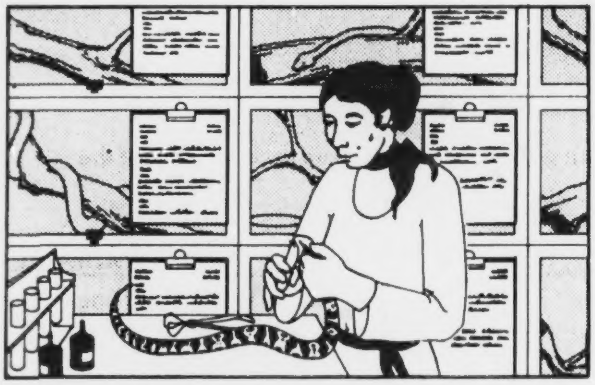
1 Agronomist:

is concerned with crop production and the management of farm lands



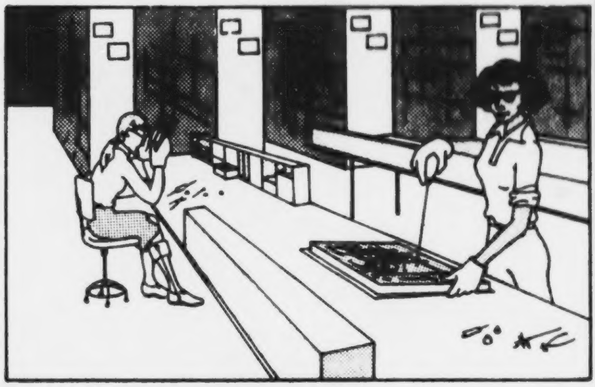
2 Civil Engineer:

designs and builds bridges, highways and other public works



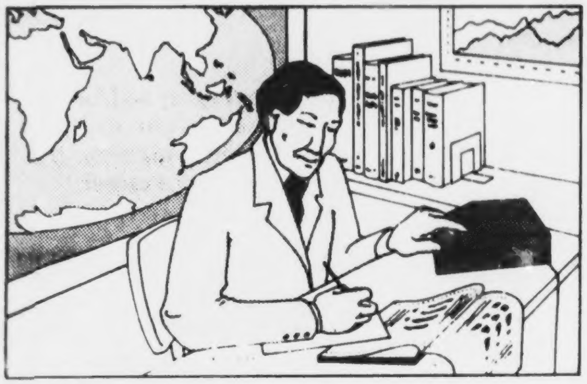
3 Herpetologist:

studies reptiles (snakes, lizards, turtles, etc.)



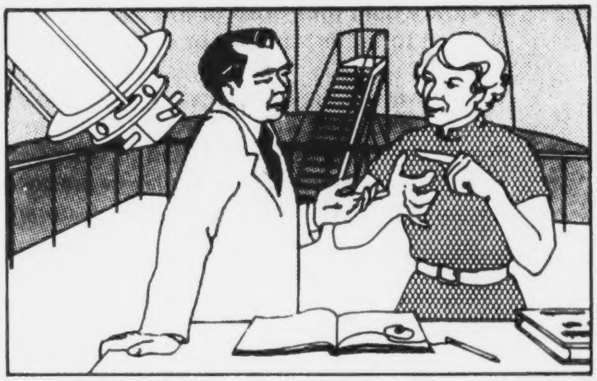
4 Electronics Technician:

works with electronics components to build communication equipment, computers, etc.



5 Demographer:

studies data about human populations



6 Astronomer:

studies matter and energy in outer space mathematics, enjoyment in working with telescopes and other scientific equipment, desire to communicate, etc. Most astronomers are pure researchers. They discuss theories about galaxies and universes, stars and planets, time and space. The space program has depended upon astronomers to achieve its success.

From our discussion of this transparency, can you say that all science careers are alike? No, there is great variety in science careers.

Optional Activity 2

Purpose: To give students an opportunity to discuss science careers of their choosing.

This optional activity is similar to Optional Activity 1 in that students will discuss pictures that illustrate science careers. Provide well illustrated magazines (e.g., Scientific American) which show science careers either in the text or as part of the advertising. Encourage students to find pictures that show people working in careers that might interest them.

Help students focus on the pictures by letting them cut the pictures from the magazines and mount them on plain sheets of paper or on a bulletin board. When students have selected their pictures, ask them to think about the following questions. Write the questions on the board if it will be helpful:

- What is the person(s) doing?
- Why do you think the work is important?
- Would you like to have the science career shown in the picture? Why? Why not?

In the discussion bring out as many ideas about each picture as possible from each member of the class.

Optional Activity 3

Note: This activity requires preparation time. Tell your students about the activity at the end of one class period so they can come prepared for the next class period.

Purpose: To give students an opportunity to explore a science career.

Ask students to think of a science career which might interest them or with which they are familiar. They might consider a career discussed in Optional Activities 1 or 2, or a different career. Ask students to consider the following questions about their chosen "careers":

- What kind of work would they do in this career?
- How would they dress in this career?
- What tools, instruments or equipment would they use?

The answers to the questions will appear in dramatizations. Students may find it necessary and/or enjoyable to work in small groups of two or three students to make the dramatizations effective. Preparation time should be used to work out a small skit about the "career." The dramatizations should allow students to role play in the careers and identify with people in that science career. Encourage students to dress up in appropriate costumes and to use appropriate props.

Optional Activity 4

Note: This activity is for students (perhaps only one or two in a class) who are especially curious about specific careers in science. The activity will require preparation, so discuss it in one class period, and set aside time in another period for the presentations.

Purpose: To give students an opportunity to research a science career about which they are especially curious.

Ask students who are interested in a specific science career to find out information about that career. Many professional associations send, free of charge, career guidance materials which discuss various aspects of science careers in their areas (see Teacher Reference). Give students time to write to these organizations to get information. When they have received the information, ask them to share it with the class in a short presentation. They should try to answer the following questions:

- Why are you interested in the career?
- Where might a person in this career work?

Teacher Reference

The following two organizations offer bibliographies of career guidance publications. One or both would be very worthwhile as they can direct you to many additional sources of information about careers in science.

National Science Teachers Association
1742 Connecticut Avenue, N.W.
Washington, DC 20009

Order "Keys to Careers in Science and Technology-1973 Edition" (cost $1.00). This invaluable booklet lists hundreds of career guidance publications, most of which you may order free. The publications cover general science careers as well as specific careers in agriculture, anthropology and archeology, architecture, astronomy and meteorology, atomic energy, aviation and space science, biological sciences, chemistry, conservation and ecology, electronics, engineering, forestry, geological sciences and oceanography, graphic arts, industrial, mathematics, medicine and health, mining and metallurgy, photography, physics, teaching and education services, and technical writing. The booklet also includes the following: where to find information on scholarships and loans, summer programs for students, award programs for students, special programs for students, programs for teachers, and agencies providing special services or support in science and technology.

Scientific Manpower Commission
1776 Massachusetts Avenue, N.W.
Washington, DC 20036

Order "Science and Engineering Careers, a Bibliography" ($2.00). It is a comprehensive bibliography of career publications published by various organizations interested in scientific and engineering education. Many of the publications are free or available at a nominal cost. All are listed by scientific area such as aerospace, biological science, computer science, etc. This bibliography is very complete and thus a fine resource for career counselors. Also order "Test Yourself for Science" ($1.00), a puzzle and problem book to test your aptitude in science.

Many professional societies have brochures about careers in their areas which you may wish to have available for your students during this activity.

American Chemical Society
Department of Educational Activities
1155 Sixteenth Street, N.W.
Washington, DC 20036

Ask for "Career Guidance Literature" packet. It includes a great variety of literature including: "A Chemistry Project from Start to Finish;" two detailed booklets, "Careers in Chemistry Today" and "Careers in Chemistry: Opportunities for Minorities;" several employment outlook surveys; and a number of occupation briefs covering chemistry careers in nutrition, chemical engineering, biochemistry, chemical laboratory technician, etc. Included are lists of accredited four-year programs as well as two-year programs in chemical technology. "Careers Nontraditional" describes the work of chemists as science writers, police chemists, museum scientists, businessmen, patent lawyers, information scientists, bankers, industrial hygienists, toxicologists, government employees, insurance personnel, computer scientists, and salespeople.

American Federation of Information Processing Societies, Inc.
210 Summit Avenue
Montvale, NJ 07645

Ask for "Facts on Computer Careers." It tells what computers do, who works with computers, and what jobs are available (clerical and keypunching, computer operating, programming, systems analysts, computer servicing or field engineering, marketing and sales, designing and manufacturing). It also describes salaries and required training.

American Geological Institute
Box 10031, Lamar University Station
Beaumont, TX 77710

Ask for "Geology, Science and Profession," and also flyers on different specializations in geology (19 available). The booklet gives a very full and interesting description of many aspects of geology -- the science, the frontiers, and the profession. It discusses the education needed to become a geologist and lists many sources of additional information. The flyers give similar information. Titles include: "Publications of value in planning an earth science career," "Geology and Me," "Geology: Science and Profession," "Employment Opportunities," "Employment Outlook," and "Careers in Earth Science."

American Geophysical Union
1909 K Street, N.W.
Washington, DC 20006

Ask for "Geophysics: The Earth in Space." Geophysics is the application of physics, chemistry, and mathematics to the problems and processes of the earth. The Geophysical Union divides geophysical science into areas, each of which is described in detail: Geodesy; seismology; meteorology; geomagnetism and paleomagnetism; oceanography; volcanology, geochemistry and petrology; hydrology; tectonophysics; planetology; and solar-planetary relationships. This booklet will be revised at the end of 1978.

American Institute of Aeronautics and Astronautics
1290 Avenue of the Americas
New York, NY 10019

Ask for "Careers in Aerospace: Within your Lifetime" ($.35 for 1-49 copies). This booklet describes the disciplines in aerospace: propulsion, fluid mechanics, thermodynamics, structures, flight and space mechanics, and energy. It tells what the aerospace engineer, scientist, or technician does. It suggests ways of evaluating if aerospace is a potential career for a student. It describes the education required for an aerospace engineer as well as lists the colleges and universities with accredited programs.

American Institute of Biological Sciences
Education Department
1401 Wilson Boulevard
Arlington, VA 22209

Ask for the brochure, "Careers in Biology." (Single copies are free; additional copies are $.20 each.) This 16-page brochure describes the work environment and salaries of people in biology careers; the biological disciplines; the allied disciplines, such as veterinary medicine, food technologists, etc.; biology of the future; addresses for additional career information; examples of position announcements; and AIBS Student Chapters.

American Institute of Chemical Engineers
345 East 47th Street
New York, NY 10017

Ask for career information. You will receive several informative pamphlets and booklets which will give you an idea of chemical engineering from production, research, product development, marketing, corporate management, legal services, etc. A list of significant contributions of chemical engineers includes synthetic organic chemicals, agriculture chemicals, extractive metallurgy, and medicinals. Films available from the Exxon Film Library are listed. Reference is made to a valuable book about financial aid, "Need a Lift?" published by The American Legion, National Emblem Sales, P.O. Box 1055, Indianapolis, Indiana 46206 (single copies $.50).

American Institute of Industrial Engineers, Inc.
Institute Headquarters
25 Technology Park/Atlanta
Norcross, GA 30092

Ask for "Industrial Engineering: The Humanized Profession." This pamphlet describes the work of industrial engineers who use their knowledge of engineering in the areas of health care, energy, productivity, distribution, safety, hunger, inflation, urban blight, pollution, etc. It describes educational requirements. It explains how management, plant design and engineering, systems engineering, production and quality, performance and operational standards, material flow systems, productivity, and operations research all are concerns of the industrial engineer. In addition to the pamphlet, ask for the lists of accredited programs leading to degrees in engineering technology and in engineering.

American Institute of Physics
335 East 45th Street
New York, NY 10017

Ask for the very informative booklet, "Physics: A Career for You?" (Single copies are free; multiple copies are $.40 each, prepaid.) Besides describing the major branches of physics, this book provides valuable considerations in assessing physics as a personal career choice. It details a typical undergraduate physics program, discusses employment opportunities, and suggests ways of gaining further information about physics.

American Nuclear Society
555 North Kensington Avenue
La Grange Park, IL 60525

Sample material available from this society contains two question and answer booklets about nuclear energy and the environment. A publications list of technical materials is also available. Very little of the information is career oriented; most is technical in nature.

American Society of Agricultural Engineers
2950 Niles Road
P.O. Box 410
St. Joseph, MI 49085

Ask for the brochure, "Did You Ever Wish You Could Change the World?" (Single copies cost $.25; 100 or more copies cost $.20 each.) This brochure describes the work of agricultural engineers now and in the future, the requirements and training for agricultural engineers, and the career opportunities for agricultural engineers.

American Society of Civil Engineers
345 East 47th Street
New York, NY 10017

This society provides a general description of civil engineering in the booklet, "Is Civil Engineering for You?" (Single copies are free; additional copies are $.25). Also, it provides flyers about specific careers in civil engineering, such as in public works, urban planning, and environmental, structural, highway construction, ocean, water resources engineering ($.05 each).

The American Society of Mechanical Engineers
United Engineering Center
345 East 47th Street
New York, NY 10017

Ask for the booklet, "A Career for the Future." This booklet describes what mechanical engineering is, what mechanical engineers do, where they work, college course work, high school preparation, college admissions, financial aid, and the differences between the engineer, the scientist, and the technician. It emphasizes that there is a place for women in engineering.

American Society for Microbiology
1913 "Eye" Street, N.W.
Washington, DC 20006

Ask for "Microbiology in Your Future." This booklet contains sections on the different fields in microbiology: medical and clinical microbiology, veterinary microbiology, public health and environmental microbiology, immunology, virology, microbial physiology and biochemistry, microbial genetics, molecular microbiology, mycology, protozoology, agricultural and plant microbiology, industrial microbiology, aquatic microbiology, food microbiology, microbial paleontology, and space microbiology. There is a section on planning your education and one on employment outlook and salaries. A bibliography is included. (Single copies are free; multiple copies are $.25 each.) Also a list of colleges and universities offering degree programs in microbiology is available ($.25).

American Society of Zoologists
Box 2739
California Lutheran College
Thousand Oaks, CA 91360

Ask for "Careers in Animal Biology." It describes the great diversity within biology in specialized fields such as animal development, ecology, marine biology, and parasitology. It discusses opportunities in teaching both at the secondary and college or university levels as well as opportunities in medicine, communication, museums, governmental agencies, public health, wildlife service, National Park Service, The Department of Agriculture, The Food and Drug Administration, The Smithsonian Institute, state agencies, and private industry. Many names and addresses are included for additional information.

Archeology Institute of America
260 West Broadway
New York, NY 10013

Ask for career information, in particular an article by John Howland Rowe, "Archeology as a Career," reprinted from Archeology, Vol. 14, #1 (Spring 1961). This article gives a clear description of archeology as well as a reading list. A list of addresses for additional information is also included.

Association of American Geographers
1710 Sixteenth Street, N.W.
Washington, DC 20009
or
American Geographical Society
Broadway at 156th Street
New York, NY 10032

Ask for "Careers in Geography." This booklet provides detailed information on careers in geography, in business, government, planning, and teaching. It includes a list of representative job titles and places of employment. It lists colleges and universities with undergraduate and/or graduate programs in geography.

Engineering Council for Professional Development, Inc.
345 East 47th Street
New York, NY 10017

Ask for general career information. You will receive a number of pamphlets which describe many different fields of engineering: nuclear, mining and minerals, metallurgical, mechanical, manufacturing, industrial, electrical, civil, chemical, automotive, agricultural, and aerospace engineering. In addition, there is a pamphlet called, "Is Engineering for You?" which describes engineering as a career. Also included is a list of publications which cover many aspects of engineering.

Entomological Society of America
4603 Calbert Road
P.O. Box AJ
College Park, MD 20740

Ask for career information. You will receive a pamphlet which describes how important insects are to a balanced ecology. It describes what people who study insects (entomologists) do and lists twenty-eight related careers. It suggests ways to prepare for a career in entomology, a field which will be of increased importance in the future.

The Institute of Electrical and Electronics Engineers, Inc.
Service Center
445 Hoes Lane
Piscataway, NJ 08854

Ask for the booklet, "Careers in Electrical/Electronics Engineering." This booklet describes what electrical/electronics engineering is and illustrates how it affects society, including such new developments as laser beams, holography, etc. It discusses where electrical/electronics engineers work. The greatest employer of electrical/electronics engineers is the defense industry, but electrical/electronics engineers can be found in every major industry as well as in hospitals, universities, research laboratories, etc. A section on what it takes to succeed in this career emphasizes assets besides academic and mathematic achievement such as self-discipline and imagination. Educational requirements are carefully detailed. Suggestions on how to find financial aid are given as well as sources of additional information from counselors, books, associations, and colleges. Universities offering degrees in electrical/electronics engineering are listed.

Institute of Food Technologists
Suite 2120
221 North LaSalle Street
Chicago, IL 60601

Ask for the booklet, "Food Science and Technology — a Career for You?" This booklet describes what food science and technology is; why it is important in industry; the type of work food technologists do; product research and development; work opportunities in general, in education and in government; how to prepare in high school and in college for a career; and financial aid available.

The Metallurgical Society of AIME
345 East 47th Street
New York, NY 10017

Ask for the informative booklet on careers in metallurgy. It discusses what a metallurgist is (someone interested in the production, use, or study of metallic materials) and what different metallurgists do (produce and refine metals, create new alloys, develop new uses for metals in combination with other materials, etc.). It describes a course of study to become a metallurgist. It lists universities with accredited courses in metallurgy.

National Wildlife Federation
1412 Sixteenth Street, N.W.
Washington, DC 20036

Ask for "Conservation Careers." It gives information about typical conservation jobs in federal, state, and local governments, private industry and educational and research institutions. It discusses how much education is necessary, where the jobs are, and how much salary can be expected. It emphasizes that conservaion careers are open to women and indicates other sources of career information in conservation.

Society of Mining Engineers of AIME
540 Arapeen Drive
P.O. Box 8800
Salt Lake City, UT 84108

Ask for two booklets: "Careers for Engineers in the Minerals Industry" and "Career Opportunities in the Mineral Industries." The first booklet discusses the minerals industry and various careers such as mining geologist, mining engineer, mineral processing engineer, and coal mining engineer. It tells where the jobs are and lists universities with accredited programs in mineral engineering. The second booklet describes additional careers, including exploration geophysics, open-pit mining engineering, geochemistry, rock mechanics, etc. It also includes a special supplement on mining education today.

The Society of Naval Architects and Marine Engineers
One World Trade Center
Suite 1369
New York, NY 10048

The Society will send information about the education needed, and career opportunities for, naval architects and marine engineers.

Society of Petroleum Engineers of AIME
6200 North Central Expressway
Dallas, TX 75206

Ask for the brochure, "Careers in Petroleum Engineering." This brochure describes the petroleum industry, the work of petroleum engineers, opportunities in drilling and well completion, in oil production, in reservoir engineering, in natural gas production, in evaluation and finance, in research, in management and in environmental control. It discusses the training needed to become a petroleum engineer, the opportunities for employment and the salary levels an engineer can expect.

If you do not have time to write to individual associations, order the following which will give a few publications from a wide variety of sources.

National Science Teachers Association
1742 Connecticut Avenue, N.W.
Washington, DC 20009

Write for "Elementary Science Packet, No. 7: Career Awareness." It includes career information from a variety of sources (e.g., American Dietetic Association, American Podiatry Association, Bureau of Labor Statistics, Dow Chemical Company, Institute of Scrap Iron and Steel, Manufacturing Chemists Association, National Advisory Council on Vocational Education through School Shop Magazine, *U.S. Army Recruiting Command, and U.S. Forest Service). In addition, it includes an interesting booklet, "How to Build 5 Useful Electrical Devices," published by the Thomas Alva Edison Foundation. Also included is the report of a conference on career exploration sponsored by the American Association for the Advancement of Science and the American School Counselor Association. Of particular interest in this report is a section on women and minorities in science. To help use all the materials, NSTA provides a teachers' guide with specific lesson plans. The packet costs $3.00.*

Activity B-2: PEOPLE IN SCIENCE HAVE VARIOUS RESPONSIBILITIES

Materials	Purpose
Activity B-2 Transparency	To explore the diversity of tasks/jobs within any area of science. To explore the opportunities for technical careers in science.

Discussion

The technological revolution of the past 30 years has dramatically created millions of science career opportunities. The electronics industry alone has created many of these jobs. It was only in the early 1920's that the electronics industry began. Now, this industry is increasing faster than the average for all industries through the mid-1980's. Many people, such as business executives, doctors, and mechanics rely on electronics to enable them to do their jobs. Business executives increasingly are relying on office computers to perform inventory control, market research, and production scheduling. Doctors rely on electronic instruments to diagnose and treat many illnesses. Mechanics find malfunctioning parts in many machines and engines with the aid of electronic devices.

The technological revolution has changed the character of career opportunities. No longer do people have "careers" only if they have a college degree. Many technical careers require only one or two years of technical education. These careers are important and often lead to advancement in supervisory work.

Industrial expansion and the increasing complexity of modern technology underlie an anticipated increase in demand for technicians. Many will be needed to work with the growing number of engineers and scientists in developing, producing, distributing, and maintaining new and technically advanced products. Automation of industrial processes and growth of new work areas such as environmental protection and urban development will add to the demand for technical personnel. To keep up with developments and to qualify for promotions, all employees, regardless of their responsibilities obtain additional technical training, read technical publications, and attend lectures and technical demonstrations.

Many aspects of work in science, especially in industry, rely on teamwork. Just as on any team, on science teams there are different areas of responsibility. Usually science teams are led by scientists, engineers or other highly trained personnel. These leaders explore ideas and theories. They often leave the application of the ideas and theories to their technical staff which work under the leaders' supervision. It is the technicians who carry out ideas. For instance, they are the ones who work out the details for improving mass transit, for developing new communication equipment, for creating instruments to safeguard our environment, for creating new consumer products, etc. Technicians often supervise production workers to insure quality production in line with specifications.

This activity is designed to familiarize your students with the many responsibilities within any area of science and to describe the opportunities available in technical careers.

Activity

Write RESPONSIBILITIES on the blackboard.

Today we are going to discuss various responsibilities in science-related careers. How many of you have ever played baseball or softball? Most of your students probably have played these sports.

Do all the players on a baseball team have the same responsibilities? No; one pitches the ball, another plays catcher, three cover the bases, etc. Each player has specific responsibilities.

Which player do you think is most important? Answers will vary. Most students will probably say the pitcher, but point out that all the players have very important roles to play. The game is not usually won just through the work of the pitcher. All the players work together, as a team.

Can you think of any ways that a team of people in a science career might be like a team of baseball players? Try to elicit as many answers to this question as possible. For example, each member of the team has a specific role; each team member has different responsibilities; different members have different skills; some members get more attention than others; or some members get more to do at a particular time.

Let's think about how different members of a science team have different responsibilities. Point to the word you wrote on the blackboard. **Instead of thinking of a baseball team and the roles each player has, think of a science team. What roles do you think the members might have?** Answers will vary. Try to elicit the idea that one or two members probably direct the work. These people are highly trained. Other members, such as technicians, are the "doers." They carry out the ideas and directions of the leader(s). If the science team is in industry or manufacturing, other members will work in assembling, inspecting, and processing a product. Still others might sell, install, and maintain the product.

Do people ever change responsibilities on a science team? Yes. Often a project will change, requiring new personnel to be added. Sometimes a person can learn a different skill on the job. Those who wish to take on additional responsibilities (they may be promoted) usually continue their education.

Show your students the transparency so that they can get an idea of some of the technical jobs that are now available. The transparency has a long list of technical/semiprofessional occupations. Discuss all or part of it to meet the needs of your students.

Optional Activity

Purpose: To give students the opportunity to discuss the range of scientific research from "basic" to "applied."

Materials: Copies of B-2 (optional) handout

Sometimes scientific research is described as "basic" or "applied." "Basic" research aims at uncovering new insights, ideas, and theories. "Applied" research uses the discoveries of basic research. In actuality, the two kinds of research overlap. However, research at a college or university tends to be more "basic," with less work on applications, while research in an industrial laboratory tends to be more "applied," as it focuses on the practical needs of the company. Four examples of the close relationship of "basic" and "applied" research follow.

The discovery and use of radium. Pierre and Marie Curie knew that radium existed but that no one had ever isolated it. To do that was like looking for a needle in a haystack. For four long years, from 1898 to 1902, they worked to extract radium from an eight-ton pile of impure ore. What they had in the end was barely one-tenth of a gram of pure radium salt. But they also had a revolutionary piece of matter, because scientists up to that point believed that all matter could be neatly classified into three different states: solid, liquid, and gas. Radium was different. It was not stable because it spontaneously released sizable amounts of energy. In the process, its size was reduced.

Once radium was isolated, scientists, working in applied research tried to figure out how to use it. They found, for instance, that radium could destroy cancer cells, that it could be used to identify internal flaws in metal, and that it could make paint luminescent.

The discovery of what has become known as the "germ theory" and how it changed medical practice. One of the most dramatic contributions of science was the discovery of the "germ theory." Others before Louis Pasteur suspected that micro-organisms might be responsible for disease and decay, but it was not until 1865 that Pasteur found evidence to prove it. Pasteur was asked to save the French silkworm industry. He discovered a parasite which was infecting silkworms and the mulberry leaves which the worms ate. Rather than treat the infected worms and plants, he ordered them all to be destroyed and replaced with new silkworms. Once the infected worms and plants were gone, the disease was gone also. Thus, Pasteur was able to conclude that the parasites were responsible for the disease. Pasteur's discovery has been called the greatest single medical discovery because it unlocked the secret of controlling infectious disease.

A PARTIAL CHECKLIST OF TECHNICAL/ SEMIPROFESSIONAL OCCUPATIONS

- Aeronautical technician
- Agricultural technician
- Air-conditioning, heating,and refrigeration technician
- Architectural technician
    - Urban planning technician
- Automotive technician
- Broadcast technician
- Chemical technician
- Civil engineering technician
- Computer programmer
- Computer technician
- Drafter
- Electrical technician
- Electromechanical technician
- Electronics technician
- Environmental control technician
- Fire protection technician
- Food processing technician
- Forestry technician
- Health service technician
    - Dental hygienist
    - Dental laboratory technician
    - EEG technician
    - EKG technician
    - Medical laboratory technician
    - Oxygen-therapy technician
    - Radiologic technologist
- Industrial production technician
- Instrumentation technician
- Laboratory technician
- Library technician
- Marine-life and ocean-fishing technician
- Mechanical technician
    - Diesel technician
    - Machine designer
    - Tool designer
- Metallurgical technician
- Nuclear engineering technician
- Oceanography technician
- Police science technician
- Safety technician
- Surveyor
- Veterinary technician

In 1867 Joseph Lister, realizing the importance of Pasteur's germ theory, used carbolic acid (phenol) to fight infections during surgery. For this he is known as the founder of antiseptic surgery. Pasteur also was quick to put his theory to work. During the Franco-Prussian wars he was appalled at the unsanitary conditions in military hospitals. He urged the doctors to boil all their instruments and steam their bandages to sterilize them. These simple procedures, which are taken for granted in today's hospitals, prevented innumerable infections. Wherever Pasteur encountered disease he looked for germs which might cause it. He discovered that anthrax, a deadly and highly communicable disease of cows, pigs, and sheep, was caused by germs. The only treatment was again to destroy all the infected animals to destroy the germs. But once Pasteur realized the cause of anthrax, he set about developing a vaccine which would protect livestock from the disease. This he did by creating a mild version of anthrax which he used to infect a sheep. Later this sheep did not contract a more serious case of anthrax because it had been able to develop antibodies from the vaccination. Pasteur even theorized that rabies was caused by a virus, although the virus was too small to be seen by a microscope. Nevertheless, Pasteur went ahead and developed a vaccine for rabies, which he successfully tested on a small boy who had been bitten by a rabid animal.

The development of dynamite. Ascanio Sobrero discovered the remarkably destructive powers of nitroglycerine, a chemical compound he made by slowly adding glycerine to a mixture of nitric and sulfuric acid. He was too horrified at the explosive power to exploit it. However, twenty years later, Alfred Bernhard Nobel discovered a way to "tame" nitroglycerine. By accident, some nitroglycerine leaked and the liquid was absorbed by a packing material which contained diatomaceous earth. Nobel found that in this dry combination nitroglycerine was safe until set off with a detonating cap. He called his invention dynamite. Nobel made a fortune with this invention. Upon his death, he endowed the Nobel Prizes in honor of great scientists, peacemakers, and writers.

The discovery of the laser beam and the applications scientists are finding for it. In recent years there have been many articles discussing the uses of the laser beam. In 1950, a German-French physicist developed a technique of "optical pumping." By "pumping" atoms with light frequencies which they were able to absorb, atoms could, for an instant, attain a high energy state and emit light. In 1953, Charles Townes, an American physicist, managed to get ammonia molecules to emit a steady microwave beam. This beam was called a maser (Microwave Amplification by Stimulated Emission of Radiation). The steady vibrations of the microwave beam made it possible to develop an atomic clock which is far more accurate than any clock ever made. Maser beams could amplify extremely weak sounds so they were used to amplify faint sounds from the satellite Echo I.

In 1957, Townes speculated on the possibility of creating a maser beam that would produce infrared or even visible light instead of just microwaves. These visible light masers would be called Lasers (Light Amplification by Stimulated Emission of Radiation). Townes shared the 1964 Nobel Prize for physics with two Russian scientists who worked out the same theory.

In 1969, Theodore Maiman turned Townes' theory into reality. He made the first laser beam, a beam of light which had only a single wavelength and in which all waves traveled in the same direction. Such a beam of light can travel thousands of miles without dispersing or it can be concentrated into so small a spot that it produces heat hotter than the surface of the sun. The laser has many uses. Engineers use laser beams to cut concrete and steel; doctors use laser beams to perform delicate eye surgery; TV producers use laser beams to make holographic images; earthquake scientists (seismologists) use laser beams to predict earthquakes by tracking moving plates of rock along a fault. Laser beams are already considered our next great source of energy, and the military is developing many war-time uses for the laser, from laser-guided bombs to laser guns capable of creating an arms war in space.

From the previous four examples, it is evident that there is often a short time between the basic research and discovery of new facts, theories or phenomena, to the practical application of these facts, theories and phenomena.

ACTIVITY B-2 (Optional)

Science Involves Both Basic and Applied Research

Directions: *Put the number from one item in the basic research column on the line beside the matching item in the applied research column.*

Basic Research

Basic research leads to new ideas and discoveries.

1. J. H. Wegstein discovered a way to classify fingerprints.
2. Charles Richard Drew discovered that blood plasma is better for blood transfusions than whole blood.
3. In 1937, Maria Telkes discovered the first thermoneuclear cell, a cell which makes electricty from heat.
4. In 1837 Samuel F. B. Morse discovered how electricity can pass through an electromagnet and move a pencil. A year later he demonstrated a model telegraph machine.
5. John Gorrie received the first American patent for an ice machine in 1851.
6. Thomas A. Edison, who was deaf, invented the incandescent lamp in 1879.
7. Florence Rena Sabin described the lymphatic system in the early 1900's.
8. In the 1940's, John Bardeen, Walter H. Brattain and William Shockley invented the transistor.

Applied Research

Applied research uses the discoveries of basic research to find ways of improving our lives.

____ a. Red Cross set up blood banks for emergencies.

____ b. In 1964 Robert H. Weitbrecht, who is deaf, invented a terminal unit for a teletypewriter for the deaf.

____ c. The FBI uses a computer to scan and identify fingerprints.

____ d. Mary Pennington established standards for refrigeration for railroad cars.

____ e. Diseases of the lymphatic system (e.g., Hodgkin's disease, typhoid fever, malaria, leukemia) are being researched.

____ f. In 1946, the first "solar" house was designed. It was heated by the sun's energy, themoelectrically.

____ g. Scientists developed hearing aids which use transistors to amplify sound.

____ h. Edison developed dynamos for generating and distributing electric light and power.

Write SOME SCIENTISTS MAKE DISCOVERIES: OTHERS USE THEM on the blackboard. **Can you think of any examples of this happening?** Answers will vary according to the experience of your students. Use one or more of the examples from the discussion printed above to help you with this question. During this discussion, write the words BASIC RESEARCH and APPLIED RESEARCH on the blackboard.

What is done by a person working in basic research? Those working in basic research look for new ideas and theories.

What is done by a person working in applied research? Those working in applied research look for practical applications of the new knowledge gained from basic research. Both kinds of research often overlap and it is difficult to make clear distinctions.

Pass out copies of the handout. This handout has examples of basic research and applied research. Your task is to match the applied research with the basic research that made it possible. Let's do the first few examples together. Work through the first two examples with your students. Explain each item as needed. Then allow time for them to finish the handout independently. Check the answers as the students finish.

KEY: 2.a 4.b 1.c 5.d 7.e 3.f 8.g 6.h

Which research is more interesting to you, basic or applied? Again, answers will vary. Try to expand on this question so that the students have a sense that they could choose to do either kind of research. Also make sure that the students realize that a person working in science does not have to choose basic or applied research.

Teacher Reference

Asimov, Isaac. Asimov's Biographical Encyclopedia of Science and Technology. Garden City, N.Y.: Doubleday & Co., Inc., 1974.

This is an excellent reference source for biographical data about scientists and inventors.

Suggested Student Reading

Burlingame, Roger. Scientists Behind the Inventor. New York: Harcourt, Brace and Co., 1960.

This book discusses in a lively way how scientific work leads to inventions.

Curie, Eve. Madame Curie. New York: Doubleday & Company, Inc., 1937.

This is a biography of Madame Curie by her daughter.

Edson, Lee. "The Advent of the Laser Age," The New York Times Magazine. March 26, 1978.

This article gives detailed information about the history and nature of the laser beam and it discusses many uses of the laser beam.

Activity B-3: PEOPLE IN SCIENCE OBSERVE THE NATURAL WORLD

Materials	**Purpose**
Activity B-3 Transparency	To explore how people in science use five senses to observe the natural world.

Discussion

The focus of this activity is on observing through the five senses: tasting, hearing, seeing, smelling, and touching. If an individual is considering a science career, his or her ability to observe will be important, but that person need not have use of all five senses to be a perceptive observer.

Specifically this activity allows your deaf students to realize that even without the sense of hearing, there are many opportunities open to them in science. Also, because of their hearing loss, your students may have a heightened interest in studying certain areas of science (e.g., animal communication, nerve function, certain diseases, etc.).

People do not all have the same ability to use their senses. For example, some people see better than others, or some people have a more acute sense of smell than others. In choosing a career, a person's individual abilities should be carefully considered so that the person uses his or her talent to the greatest advantage (see Activity A-3 for an exploration of assets and abilities).

The Teacher Reference provides information regarding a "hands-on" experience which could be done prior to the activity.

Activity

How do you think people in science find out about the natural world? Answers will vary. At first your students will probably say that they study it, read about it, and talk about it. Point out that those in science look at the natural world, listen to it, taste it, touch it, and smell it.

On the blackboard, write the words TOUCHING, HEARING, SEEING, SMELLING, and TASTING.

Can you think of one word that describes what people in science do when they use one of these senses to get information about the natural world? Try to elicit the work OBSERVE. Write it on the board. (If you sign in your classroom, discuss with your students the significance of the sign for "observing," as they might think of observing primarily as a visual experience and disregard the other four senses.)

What does a scientist do when he or she looks at an ant colony in order to study it? Observe.

What does a scientist do when he or she smells a chemical reaction in order to study it? Observe.

What does a scientist do when he or she touches a plant to feel its surface? Observe.

Can you think of other examples of scientists observing? Answers will vary. Elicit answers until you are certain your students understand that scientists observe with one or more of their five senses.

Show the transparency.

Let's look at pictures of some scientists who are observing as part of their work. As we look at each of these pictures, I am going to ask you three questions. Write the questions on the blackboard as you introduce them so that your students can think about them throughout the activity.

- WHAT DO YOU THINK THE PERSON IS DOING?
- WHAT SENSES ARE BEING USED BY THE SCIENTIST(S)?
- COULD A DEAF PERSON DO THIS TASK/JOB?

Let's start with picture #1. What do you think this person is doing? The person is touching a piece (fragment) of a skull. It appears that the person might be interested in how the jaw operates, perhaps for archeological, anthropological, or medical reasons.

What senses are being used by this person? The person is getting information by touching the skull and looking at it (seeing).

Could a deaf person do this task/job? Yes, a deaf person could do this job if trained to look for important aspects of the skull.

Now look at #2. What do you think this person is doing? This person is working with a microscope. She is going to observe something in the dish (Petri dish) she is picking up. She is in a laboratory. Notice the test tubes on the table. She is probably studying plants. Notice the poster on the wall behind her.

What senses are being used? She is primarily using her eyes (seeing) although she also needs finger dexterity and eye-hand coordination to operate the microscope.

Could a deaf person do this task/job? Yes, a deaf person could do this job if trained in what to observe.

Now, look at #3. What do you think this person is doing? This person is walking in a dense woods. The moss hanging from the trees and the heavy gound cover of ferns suggest a tropical or sub-tropical forest. The boots worn by the person suggest there might be a danger of snakes. The netting over the face suggests that there are annoying, if not dangerous, insects flying in the air. This person could be collecting specimens of plants, insects, or reptiles to be placed in the case.

What senses are being used? Seeing is the major sense; however, touching and smelling are also important, especially in gathering or identifying specimens.

Could a deaf person do this task/job? Yes, a deaf person would be able to do this job if the person knew what kinds of things to find.

Now, look at #4. What do you think these people are doing? One worker is seated at a screen (oscilloscope) which is displaying some information about a dolphin, perhaps the sounds the dolphin makes. Notice that this person has some auditory aid in his ear. This could either be part of the equipment or could indicate that this person is hearing impaired. The other person is standing behind the first. This person has earphones and is listening to the sounds the dolphin makes. They are both studying communication among dolphins.

What senses are being used? The first person studies the screen with his eyes (seeing). The second person is looking at the screen (seeing), and also listening (hearing) to the sounds the dolphin makes through earphones.

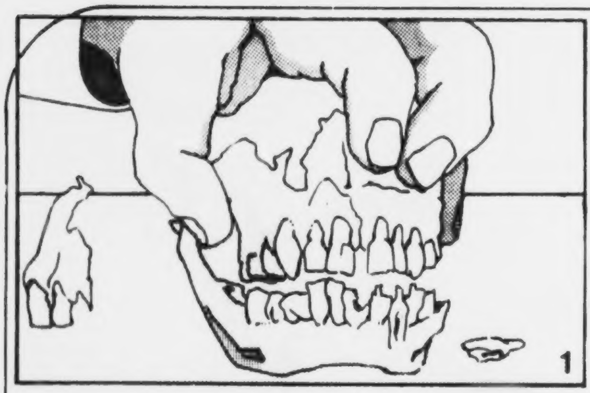
Could a deaf person do this task/job? A deaf person could study communication among dolphins. A deaf person might be very interested in studying communication because of his or her familiarity with the equipment used to test speech production and his or her unique understanding of the importance of communication.

Now, look at #5. What do you think this person is doing? This man is adjusting dials as he observes a graph being made on a machine. It appears that the graph might show signals being picked up by the antenna outside the window. Radio-wave antennae, some much larger than the one shown here, can receive signals from outer space.

What senses are being used? To understand the graph, the man has to be able to see the markings and distinguish the significant variations, so he relies heavily on his sense of sight. He also must use his sense of touch to operate the dials. Even though he is "listening" to the sounds from space, he is "listening" with his eyes.

Could a deaf person do this task/job? Yes, a deaf person could do this job, especially because the "listening" is done through the eyes rather than the ears. A hearing person would not be able to hear these sounds without the aid of the machine.

Now, look at #6. What do you think these people are doing? These people appear to be in a very cold place. Notice their parkas. They are using instruments to measure the movement of a glacier. Notice the black poles marking where the glacier has been.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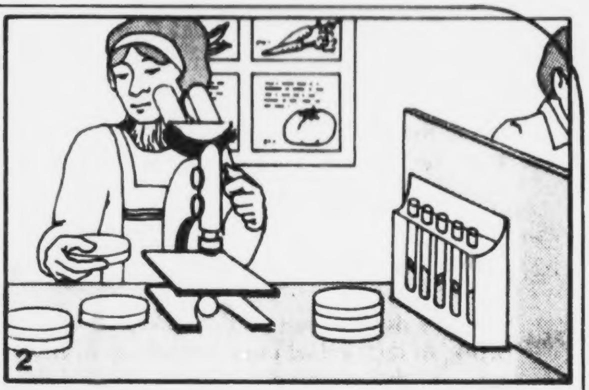
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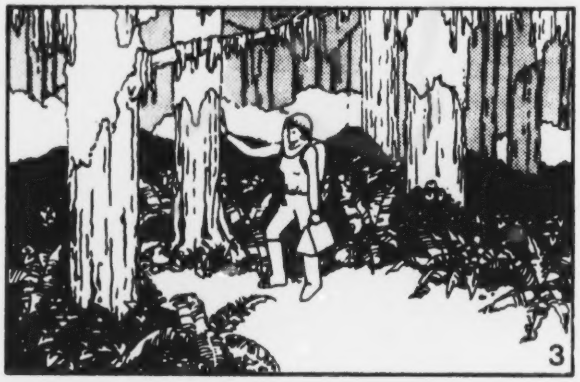
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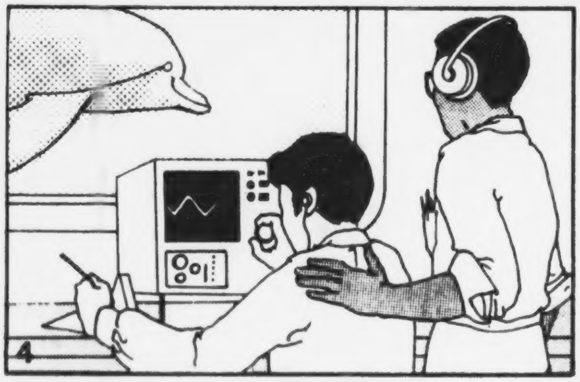
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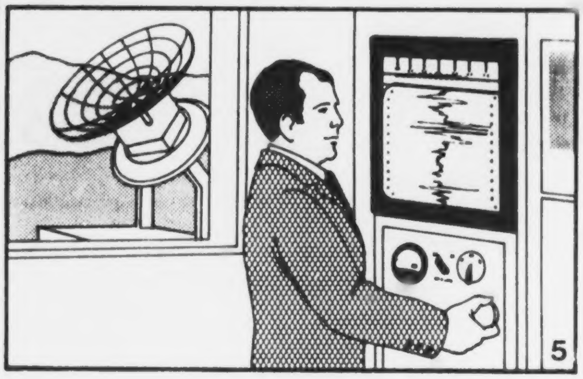
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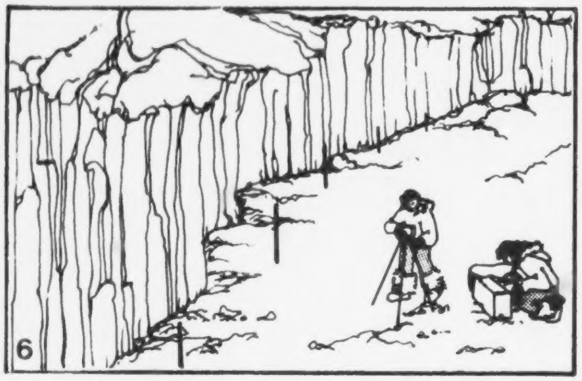
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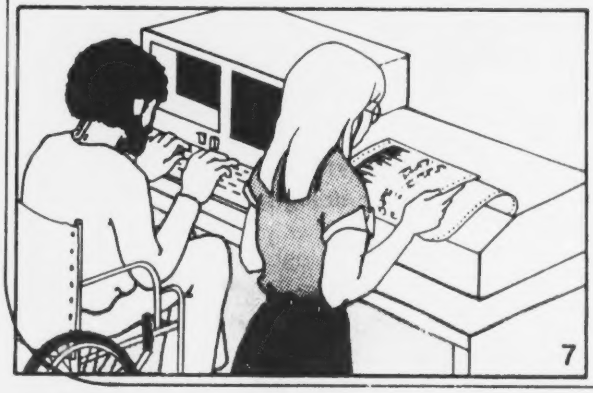
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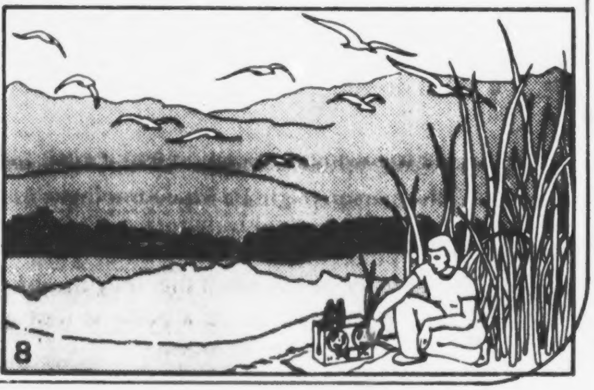

8

BEST COPY AVAILABLE

What senses are being used? The people have to handle their instruments carefully. They also have to set the instruments in the proper place and read the findings (seeing).

Could a deaf person do this task/job? Yes, a deaf person could do this job if trained in how to use the instruments.

Now, look at #7. What do you think these people are doing? One person is typing information into a computer. The other one is reading the print-out, after the information has been processed. Notice that one scientist is shown in a wheelchair. People can find productive work in spite of physical disabilities. This person's disability, unlike others, is readily apparent. Thus, the picture may spark discussion. His disability does not interfere with his science career.

What senses are being used? Both people need to see well. The person typing needs especially good eye-hand coordination and finger dexterity.

Could a deaf person do this task/job? Yes, a deaf person could do this job if trained in computer work. In fact, a deaf person might have an advantage as he or she would not be distracted by the noise of the machine.

Now, look at #8. What do you think this person is doing? This person is working with a tape recorder in the field. He is probably taping the sounds of the birds. He might use the binoculars to spot and/or identify specific birds.

What senses are being used? For the binoculars, the person needs to use his eyes (seeing). For the tape recorder, the person uses his sense of touch to turn it on and off and adjust the volume, tone, etc. He also uses his eyes (seeing) to see when the tape is used up. Most importantly, he uses his sense of hearing to know when and what to record.

Could a deaf person do this task/job? A deaf person might be able to do this job to a degree. Certainly a deaf person would have trouble hearing the sounds to record. However, working with a hearing person might enable the deaf person to operate the tape recorder. Also, the sound indicator which is on many tape recorders might enable the deaf person to know when to record. Furthermore, in some research it is important to make recordings at specific time intervals, for instance, every five minutes. Certainly, a deaf person could perform this task as the criticial factor for recording is time, not sound. A deaf person would have little difficulty using the binoculars, unless finding a bird depended upon hearing it first.

Did we discuss any task/job that could not be done by a deaf person? A few of the tasks/jobs might be more difficult, but almost all of the tasks/jobs could be done independently by a deaf person. The point to emphasize is that the deaf person, or for that matter, any disabled person, can often adapt the task/job to fit his or her abilities. In other words, physically disabled people can find careers in science that allow them to contribute their special skills and abilities.

Optional Activity

Note: This activity is for students who have strong language ability.

Purpose: To explore observation in the context of specific science careers.

Your students might be interested in knowing the names given to the people who do the kind of work pictured on the transparency. For each picture, ask the following two questions to start a discussion:

- **What do you think the person is studying?**
- **What do you think he or she wants to find out?**

Use the following information about each picture in your discussion.

1. This person might be a paleontologist (pā–lē-än-täl′ə-jəst). A paleontologist studies fossils to learn about prehistoric forms of life.
2. This person might be a microbiologist (mī-krō-bī-ol′-ə-jəst). A microbiologist studies forms of life which are so small that they must be studied under a microscope.
3. This person might be a botanist (bot′ə-nəst). A botanist studies plants. This one may be collecting plants for study.

4. These people might be zoologists (zō-ol′ ə-jəsts). A zoologist studies animals. These zoologists might be studying the language of dolphins.
5. This person might be an astronomer (ə-stron′ə-mẽr). An astronomer studies matter in outer space. This one may be sending radio waves into outer space and studying those radio waves that come back to earth from outer space.
6. These people might be geographers (jē-og′ rə-fers). Geographers study the earth. These geographers are glaciologists who are studying glaciers.
7. These people might be statisticians (stat′ is-tish′əns). Statisticians design experiments, collect, and classify data. They often use computers.
8. This person might be an ornithologist (ôr′ ni-thol′ ə-jəst). Ornithologists study birds.

Teacher Reference

In this activity, observation of the natural world was discussed. It would be appropriate at this time to provide your students with a "hands-on" experience, an experience which will require close observation and also which will excite your students about science. One such experience might be to raise butterflies in your classroom. Where this has been done, students have been motivated to learn more about science because they greatly enjoy watching this natural phenomenon take place. If you are interested, write to:

Insect Lore Products
P.O. Box 1535
Shafter, CA 93263

This company offers several different classroom kits for raising Painted Lady and/or Buckeye butterflies.

Butterfly Garden School Kit supplies all classroom materials and larvae for 30 Painted Lady butterflies ($18.00 + $1.50 postage).

32 Frame Painted Lady Butterfly Filmstrip describes butterflies in nature and their culture in captivity ($6.50 + $.50 postage).

Butterfly Garden. Painted Lady or Buckeye Butterfly ($8.50 + $1.50 postage).

Painted Lady and Buckeye Butterfly ($13.00 + $1.50 postage) supplies all classroom materials including box for growing larvae and five caterpillers.

Live Butterfly Culture supplies five caterpillers and nutrients with instructions on care and feeding ($5.00+ $.50 postage).

Butterfly Curriculum Using the Butterfly Garden School Kit describes how to use butterfly experience for learning science skills and developing reading, language, and certain math skills ($4.50 + $.50 postage).

Activity B-4: PEOPLE IN SCIENCE SHARE THEIR FINDINGS

Materials

A set of "Discovery Cards" for the students. (The "Discovery Cards" can be made by cutting out the boxes on the white page or by copying each "discovery" onto a 3" x 5" card.)

Purpose

To discuss communication among those in science.

To explore the importance of sharing scientific information.

Discussion

Those in science work together to unravel the secrets of the natural world. They share information. One person's discovery may shed light on another person's work. Scientists publish their findings; they report their findings at conventions and conferences; they talk among themselves; and they read scientific journals. Scientists also argue about their work and that of others.

A person working in science can be serious; he or she can have a sense of humor; a person working in science can be young or old; he or she can be of any race, color or creed. But all try to be objective and precise when they talk about their work. Some can write well; others have difficulty writing; some feel comfortable delivering a speech; others do not. All try to communicate in the best way they can the excitement of their work and findings.

In this activity, your students will have an opportunity to communicate about imaginary scientific discoveries. Students may have difficulty with the kind of creative thinking involved in this activity. However, this activity should be used as an opportunity to provide experience in creative thinking, an important, but often neglected area.

The act of discovery is primarily a matter of looking at facts in a new or different way. Students should be encouraged to use their imaginations. They should try to think of sensible answers to the questions even though the "discoveries" are imaginary.

Give your students time to think about the "discoveries." Perhaps you will find it appropriate to use two periods for this activity so students will have time to prepare.

Activity

People working in science share their discoveries and inventions. How do you think they share their findings? Use the first paragraph in the discussion to help your students answer this question.

Do you think all people in science communicate their ideas in the same way? Use the second paragraph in the discussion to help your students answer this question.

You will be role-playing in this activity. You will each pretend that you are a "great," "brilliant," "dedicated," and "hard-working" scientist who has just made an important discovery. You have been invited to discuss your discovery. Your job is to present your discovery in a convincing way.

I will give each of you a card with a "discovery" written on it. Pass out the "Discovery Cards." Explain the cards as needed; some are more difficult than others. **Think about the discovery on the card. Consider the questions that I am writing on the blackboard.** Write the following questions on the blackboard:

- WHAT MADE YOU THINK THE DISCOVERY WAS POSSIBLE?
- HOW DID YOU ACTUALLY MAKE THE DISCOVERY?
- HOW WILL THE DISCOVERY CHANGE THE WAY PEOPLE LIVE?
- HOW CAN THE DISCOVERY BE USED?

Discovery Cards

You have just discovered life in outer space!

You have just discovered a strange new animal in the jungle that is as large as a dinosaur! You suspect that it is the last prehistoric animal alive.

You have just discovered an air pocket under the ocean that is big enough for the city of New York!

You have just discovered a way of electronically reading someone's thoughts!

You have just discovered a way to use the energy of the tides!

You have just discovered a way to make electric cars efficient enough for every family!

You have just discovered a way of growing enough food for a family in a kitchen closet!

You have just discovered a way of avoiding senility as people grow old!

You have just discovered a means of transporting a person from one place to another by use of thought alone!

You have just discovered a plant that provides all the daily minimum vitamin requirements!

You have just discovered a chemical that removes all pollution from the air!

You have just discovered windows for a house that can be treated with a chemical to keep out the sun's heat in summer and, when turned over, keep in the house heat in winter!

You have just discovered a cure for cancer!

You have just discovered a chemical which dissolves plastic and turns it into drinking water!

Before we begin the role playing, will someone volunteer to interview the "scientists"? The interviewer will ask the four questions that I wrote on the blackboard. The interviewer will also ask for clarification if the "scientist" seems vague about the discovery. Pick someone to be the interviewer.

Who would like to be the first "scientist" to be interviewed? Your students should be motivated enough to volunteer; if not, pick someone to start. This activity should generate humor as well as controversy. Remind your students that part of science is the challenges one receives from others to defend his or her work. It should stimulate thought about how scientists communicate with each other. Give your students the time they need to do this activity well. Give several students the chance to be the "interviewer." After the interviewer asks the four questions, other members of the class should ask additional questions. Extend each discussion to meet the interest and needs of the whole class.

Notes and Comments

Alexander Graham Bell patented the telephone in 1876. He communicated the news of his invention by the dramatic demonstration at the Centennial Exposition in Philadelphia. Very quickly the telephone was a commercial success.

To Bell, even before he invented the telephone, communication was extremely important. In the many years he taught deaf students, he tried to help them communicate as effectively as possible with both deaf and hearing people. In a sense, Bell acquired his conviction for the importance of effective communication from his father who was a teacher of elocution. His father developed phonetic symbols which he called "Visible Speech." Bell quickly saw the application of these symbols for teaching deaf students and achieved a large measure of success with them. He established a school for the deaf in Boston.

Bell, whose wife and mother were both deaf, said, "There are very few positions in life which cannot be occupied by deaf persons. Nearly all of the arts and industries are open to them, and many of the professions."

Teacher Reference

Bruce, Robert V. Bell: Alexander Graham Bell and the Conquest of Solitude. Boston: Little, Brown and Company, 1973.

This detailed biography provides valuable insights into the life of Alexander Graham Bell – inventor, teacher of deaf students, phonetician, and sage.

Suggested Student Reading

Science fiction is an appropriate follow-up to this activity.

Activity B-5: PEOPLE IN SCIENCE OFTEN WORK AS A TEAM

Materials	Purpose
Activity B-5 Transparency	To explore the great diversity of tasks/jobs within one area of science. To explore teamwork among those in science careers.

Discussion

This activity will explore the diversity of tasks/jobs within one area of science. Unlike Activity B-1 which discussed the many different areas of science and Activity B-2 which discussed the variety of jobs in science, this activity will focus on the variety of jobs within one area.

Many people have the idea that a scientist always works alone. In the past, this idea has kept some students from going into a science career. Technology has given those in science so many new tools that, more often than not, a person working in science is part of a team. Each member of that team contributes a special knowledge.

This concept is one which may be uncomfortable for the deaf student who is concerned about communicating with hearing individuals, so attention needs to be given to the positive aspects of working with other people. (The filmstrip shows how some deaf individuals in science careers do communicate with their colleagues.)

Archeology, for example, is a science that relies on many specialists. Archeology is the study of the human past. The archeologist tries to reconstruct history, not from the written record, but rather from the things people have left behind. The archeologist does extensive and very careful field work to collect data which are then carefully analyzed in the laboratory. Archeologists study such diverse things as Egyptian pyramids, sunken treasures, human fossils, the earliest cultivation of corn, Easter Island monoliths, trade routes. The list is as long as what human culture has produced. It is no wonder that archeologists need many skills and rely on many specialists to help them in their work.

Activity

What kinds of things can you do better with help than by yourself? Answers will vary. Answers might include playing sports, lifting heavy objects, climbing a ladder, discussing ideas.

Do you think people in science ever work together on teams? Your students will probably say "Yes." Expand the students' concepts about teamwork in science by using information in the discussion and in Activity B-2, and as demonstrated in the filmstrip (Activity A-1).

I am going to show you a transparency entitled "Teamwork in Archeology." Show the transparency. Explain what archeology is. Describe the four major activities that are illustrated: surveying the site, studying in the lab, identifying objects and making tests in the lab, and discovering bones and artifacts in the field. It is not important that the students know the terms for the various tasks/jobs illustrated, rather they should get an idea of the variety of jobs possible within one field of science. If your students are curious about the different names shown on the transparency, see Optional Activity 1.

What training do you think is required for these jobs? Some of the individuals illustrated may have a high school education, others may have earned an associate degree after two years of college, while others may have completed college and/or gone on for graduate work.

Optional Activity 1

Note: This activity is recommended for students who have good language ability.

Purpose: To explore in detail the jobs of people in one area of science (archeology).

Show Activity B-5 transparency. **We are going to explore the kinds of expertise or knowledge each of these people has. Does each person have the same science background?** No. The names indicate that they have special skills, even though they are all working in the area of archeology.

What do you think some of the skills are that these people have? Some are using scientific tools (microscope, surveying instrument, magnifying glass, Bunsen burner, etc.). Some are taking careful notes (petrologist and geochemist). Some are discussing things found in the field (upper left, lower right hand corners).

What special knowledge (expertise) does each person bring to the work? Your students may not have any idea, as the names will be unfamiliar. Use the following descriptions to help your students understand the different scientific specialties.

Geologist: (jē-äl′ə-jəst) A geologist is interested in the history of the earth and its life, especially as it is recorded in the rocks. This geologist probably has a special interest in the rocks found at this archeological site.

Surveyor: (sər-vā′ər) A surveyor has special skill in mapping an area. Surveyors use their instruments to define exact boundaries. This surveyor is probably using his skills to map this site.

Paleoanthropologist: (pā-lē-ō-an-thra-päl′ə-jəst) A paleoanthropologist studies human fossils, primarily to determine the evolution of the human species. This archeological site may have fossil remains that would require the skills of a paleoanthropologist to understand.

Petrologist: (pə-trä′ lə-jəst) A petrologist is a special kind of geologist. Both study rocks. The petrologist is interested in the origin, history, occurrence, structure, chemical composition and classification of rocks.

Pedologist: (pə-däl′ ə-jəst) A pedologist studies soil. The one shown on the transparency appears to be taking soil from a specimen.

Palynologist: (pal-ə-näl′ə-jəst) A palynologist is concerned with pollen and spores. (Pollen is from flowers; spores are from non-flowering plants.) A palynologist works with either living or fossil specimens.

Paleontologist: (pā-lē-än-täl′ə-jəst) A paleontologist is interested in past geological periods. He or she studies fossil remains of plants and animals to see how modern plants and animals are related.

Geochemist: (gē-ō-kem′ əst) A geochemist studies the crust of the earth to determine its chemical composition and the actual or possible chemical changes that do or could occur.

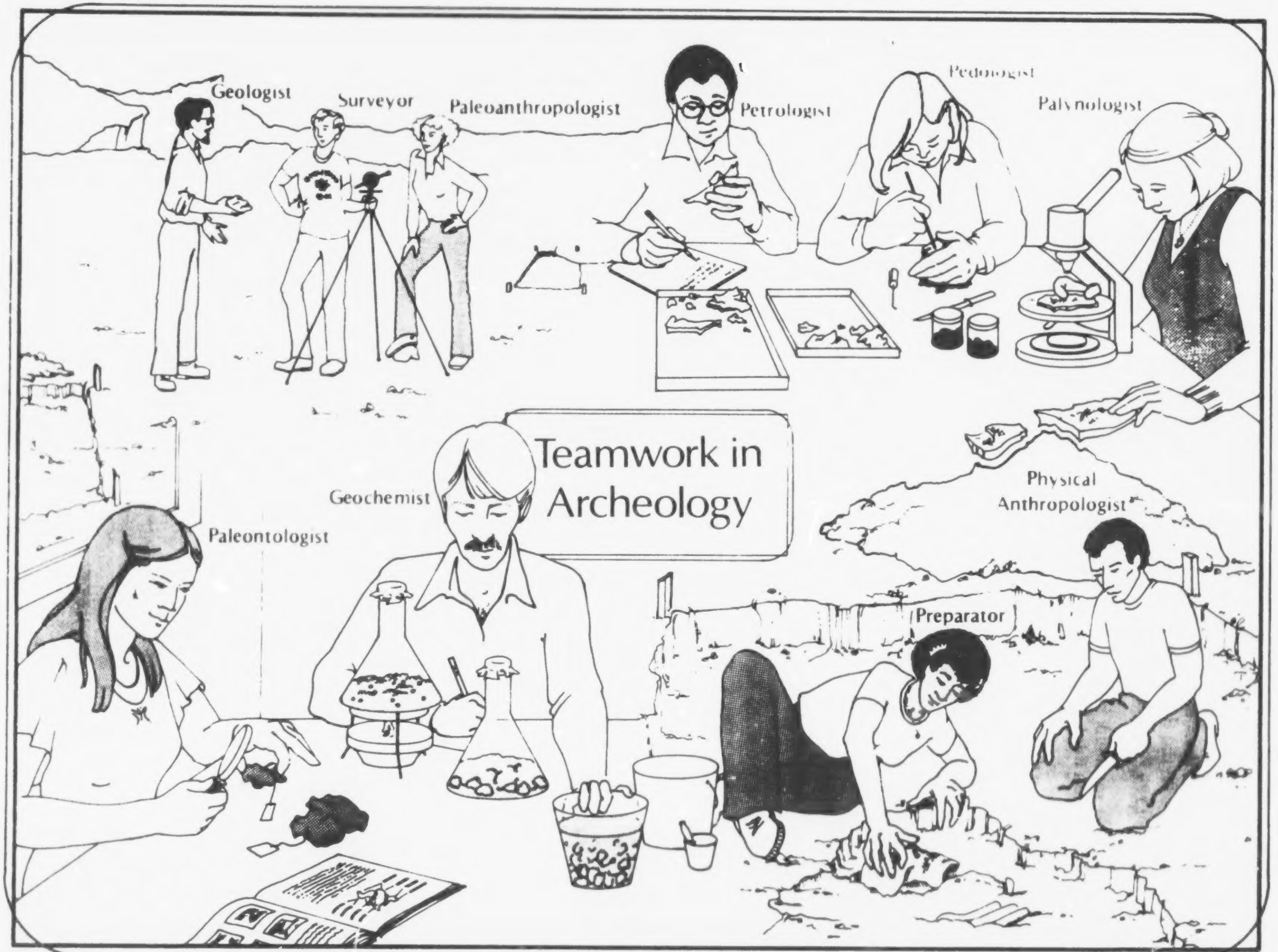
Preparator: (pre-par′əd-ər) A preparator prepares scientific specimens for study or museum display.

Physical Anthropologist: (fiz′ ə-kəl an-thra-pal′ə-jəst) A physical anthropologist is especially concerned with the comparative study of human evolution. Observation and careful measurement of skeletal remains are one of the main ways a physical anthropologist develops understanding about human evolution.

Optional Acivity 2

Purpose: To consider the teamwork that was required to get a person on the moon.

Imagine what it took to get a person on the moon. What kinds of jobs needed to be done? I will write the jobs on the blackboard as you think of them. Pictures may help your students think of various jobs. Try to bring to the classroom illustrated books about the lunar flight. As your students look at the pictures, ask them to think about the equipment shown or what is actually happening.


Geologist
Surveyor
Paleoanthropologist
Petrologist
Pedologist
Palynologist
Teamwork in Archeology
Geochemist
Paleontologist
Physical Anthropologist
Preparator

ACTIVITY B-5

If your students have trouble getting started, these questions might help:

- **Who do you think trained the astronauts? What special science skills did the trainers have?**
- **Who do you think designed the lunar space module? What special science skill did they have?**
- **Who do you think figured out the path the rocket would take to reach the moon? What special science skills did they have?**
- **Who do you think designed the clothing for the astronauts? What special science skills did they have?**
- **Who do you think built the lunar module? What special technical skills did they have?**
- **Who do you think monitored the space flight to the moon? What special science skills did they have?**
- **Who do you think designed the rockets to launch the lunar module off the moon's surface? What special science skills did they have?**

The students' specific answers in this activity are not as important as their thinking about the questions. Emphasize that the moon shot effort required great teamwork. The jobs ranged from people putting parts together in a factory, to people figuring out complex mathematical equations to keep the rocket on target. The following list indicates some of the jobs that had to be done:

- figuring out how to go - whether to use a lunar orbit rendezvous or a direct flight
- making rockets which can withstand the heat and impact of space flight
- mapping the moon to decide on a landing site
- designing clothing for the astronauts
- designing a vehicle which can travel on the moon's surface
- monitoring the space flight at mission control
- training the astronauts
- deciding what research to do on the moon

Notes and Comments

Paul L. Taylor is a deaf scientist who worked as part of the national "team" that has put us into the space age. Taylor has an 85 dB loss in both ears.

As a child Taylor went to the Central Institute for the Deaf in St. Louis. After graduating from high school in Texas, he went to Georgia Tech where he earned a B.S. in chemical engineering. From there he went to Washington University in St. Louis for his M.S. in operations research.

From 1963 to 1968 Taylor was an engineer with McDonnell-Douglas Aircraft Company. He applied his knowledge of computer software and operations research techniques to various engineering projects. He helped optimize an assembly line procedure for high volume fabrication of missile components. And he worked in a reconnaissance laboratory developing side-looking radar and special cameras for infra-red photography.

From 1968 to 1975, Taylor had responsibility as senior process engineer for design, development and implementation of various projects at Monsanto Industrial Chemical Company.

In 1975, Taylor joined the National Technical Institute for the Deaf as Chairperson of the College of Engineering and Institute College Support Team. The support team provides interpreting, note taking, and tutorial services to approximately 40 hearing impaired students.

Activity B-6: SOME PEOPLE IN SCIENCE ARE VERY COMMITTED TO THEIR WORK

Materials	**Purpose**
None	To demonstrate that some people working in science devote their entire working lives to the study of one aspect of the natural world.

Discussion

The patience, devotion, and enthusiasm of some scientists have led to some of the major advances in scientific knowledge. Students should know about this kind of scientific work; however, it should be made clear that this kind of work is unusual and not representative of science-related work in general. Students should not think that all scientific work takes a long time, for much science-related work (such as technical occupations) is relatively routine and done during regular working hours. They should also be aware that the difficulty of a task/job is relative to the individual's interests and abilities.

George Washington Carver, a black scientist, who lived from 1864 to 1943, devoted his life to agricultural research. He worked at Tuskeegee Institute in Alabama.

Carver spent his lifetime studying plants and was able to extract secrets from those plants that no one else had known. He once said, "Anything will give up its secret if you love it enough."

Carver is famous for the development of 300 by-products from the peanut and more than 100 from the sweet potato. He wanted to create a market for these plants. He knew that the same soil that had been exhausted by single-crop cotton planting in Alabama could grow productive crops of peanuts and sweet potatoes. So Carver, unlike many people who work in science, was product-oriented. Unsatisfied just with research confined to a laboratory, Carver worked hard to make others realize the value of his work. He knew how to make plastics, dyes, medicines, flour, wood stains, and fertilizers from these two plants. To dramatize his accomplishments, one night he hosted a full-course dinner which was completely made of peanut products. Carver achieved world-wide recognition for his work as a botanist, chemist, and educator.

Although Carver had great skill and patience in working with plants, he was also interested in painting. However, ironically, it was his art teacher who encouraged him to develop his scientific career by going to the State Agricultural College in Ames, Iowa in 1891.

Be sure that your students are aware of the importance of finding out what *they* can do well and pursuing that as a career goal.

Activity

Write "ANYTHING WILL GIVE UP ITS SECRET IF YOU LOVE IT ENOUGH" on the board. **This is a quotation from George Washington Carver. Do you know who George Washington Carver was?** Share with your students the information in the discussion.

Why do you think Carver thought love was so important for a person working in science? Carver loved his plants. He never tired of working with them. If a person working in science loves what he or she is studying, that person should have patience and concern enough to work until he or she finds out the "secrets."

What if a person does not love his or her work? That person might give up before finding the "secrets." **What does Carver mean when he talks about "secrets"?** For Carver, "secrets" are how things work and why they work. Scientists try to figure out the answers to these questions.

Have you ever wondered about the natural world around you? What kinds of secrets would you like to find out? Answers will vary. You might get your students thinking by suggesting some of the secrets that those in science now are trying to discover: how to live in outer space, how to use solar energy efficiently, how to develop pollution-free cars, how to use mental telepathy, etc.

Optional Activity 1

If the last question of the activity was provocative and led to an interesting discussion, your students might enjoy researching some of the topics. The following list expands on the suggestions from that discussion. You may have others to add to it:

How to live in outer space: How would we get there? How would we get food and oxygen? Who would go? Why would they go? Would whole families go to live in outer space? Would there eventually be schools, etc.? Would people live there permanently? Where would they go for vacations? Where have people been in space? Will life in space ever be like that imagined in science fiction?

How to use solar energy efficiently: What happens at night when the sun is not reaching us? Can solar energy be stored? How can we trap solar energy? Is solar energy like electrical energy? What do solar-heated houses or buildings look like? Who owns solar energy? Is solar energy expensive?

How to develop pollution-free cars: Have pollution-free cars ever been developed? Who has developed them? How far can an electric car go before it needs to be recharged? Why don't we use electric cars now? Why do gasoline engines pollute? What kinds of anti-pollution devices are on cars now?

How to use mental telepathy or ESP: What is mental telepathy? Is it possible to train people to use mental telepathy? Who can use telepathy? If everyone could develop the ability to use mental telepathy, how would that change our lives? Would you like to use mental telepathy? Have you ever thought you had mental telepathy? What would be the advantages/disadvantages of everyone using mental telepathy?

Develop with your students a list of research questions for the topics in which they are interested. Use brainstorming techniques. Use some of the strategies from the values clarification activities (A-2 through A-5) to help your students to relate to these topics. "Life style" may be an appropriate topic.

Ask your students to choose one topic and one or two of the questions for their research. The research could be reported to the class or written in a report. The form it takes depends on the time available for the research and the interest of your students.

Optional Activity 2

Some of your students may be interested in learning more about black scientists and inventors. The following list may help them identify people to study. The numbers in parentheses at the end of each entry indicate the book(s) listed in Suggested Student Reading, where more information can be found.

Black Scientists

Archie Alexander, 1887-1958, Engineer (1)

Benjamin Banneker, 1731-1806, Inventor, Mathematician, Almanac-maker (1, 2, 3)

Andrew J. Beard, c. 1850-1910, Inventor (1)

Henry Blair, c. 1804-1860, Inventor (1)

George E. Carruthers, 1940- , Physicist (1)

George Washington Carver, 1864-1943, Agriculture Scientist (1, 2, 3)

David N. Crosthwait, Jr., 1898- , Engineer (1)

Charles Drew, 1904-1950, Blood Plasma Researcher (1, 2, 3)

Lloyd Augustus Hall, 1894- , Chemist (1, 2)

Matthew A. Henson, 1806-1955, Explorer (3)

William A. Hinton, 1883-1959, Medical Scientist (1)

Frederick McKinley Jones, 1892-1961, Technician (1)

Percy Julian, 1898- , Chemist (1, 2, 3)

Ernest E. Just, 1883-1941, Biologist (1, 2, 3)

Lewis Howard Latimer, 1848-1928, Inventor, Drafter, Engineer (1, 2)

Theodore L. Lawless, 1892- , Dermatologist (1)

Jan Matzeliger, 1852-1889, Inventor (1, 2)

Elijah McCoy, 1844-1928, Inventor (1, 2, 3)

Garret A. Morgan, 1877-1963, Inventor (1, 2, 3)

Norbert Rillieuz, 1806-1894, Inventor (1, 2)

Leon Roddy, 1921- , Entomologist (3)

Lewis Temple, 1800-1894, Inventor (1)

Charles Henry Turner, 1861-1923, Entomologist (3)

Granville T. Woods, 1856-1910, Inventor (1, 2, 3)

Notes and Comments

Carver was highly committed to his work. Commitment seems to be a characteristic of many scientists, for much scientific work requires endurance, patience, and very careful work. Léo Lesquereux, a deaf botanist, shared this characteristic. He was an expert in the study of mosses, and his career took him from Switzerland to North America.

Lesquereux was born in 1806 in Neufchatel, Switzerland. His first interest in mosses began as a hobby. When he became deaf, Lesquereux started working in his father's business, but during his spare time, he would collect and study mosses. His work came to the attention of Louis Agassiz who also lived in Neufchatel. (Agassiz later became an eminent Harvard professor of zoology.) Lesquereux soon published an award-winning treatise on the restoration and development of Switzerland's peat bogs. He extended his knowledge in this field by exploring a great number of Northern European bogs.

In 1848 he emigrated to the United States and worked with Agassiz until moving to Ohio. He continued his work by traveling through the Southern Appalachian Mountains to collect mosses and other plants. The immense job of cataloguing all North American mosses fell to him when W.S. Sullivant, the director of the laboratory in Ohio, died. Until his eyes failed him, Lesquereux devoted much time to making careful microscopic studies of the many specimens in Sullivant's collection to be included in the "Manual of the Mosses of North America."

Besides mosses, Lesquereux was interested in coal. He researched how coal was formed in many states like Pennsylvania, Ohio, Kentucky. He was correct in his belief that coal and peat were formed in the same way. Lesquereux published twelve important papers on the natural history of North America. He died in 1889.

Suggested Student Reading

(1) Haber, Louis. Black Pioneers of Science and Invention. New York: Brace & World, Inc., 1970.

The biographies, presented as narratives, have interesting facts about the lives and works of the scientists and inventors.

(2) Jenkins, Edward S. (ed.), American Black Scientists and Inventors. Washington, D.C.: National Science Teachers Association, 1975.

The biographies in this book are easy to read and include many fascinating details about the lives and work of the scientists and inventors.

(3) Plostei, Harry A. and Warren Marr, III (eds.), The Negro Almanac: A Reference Work on the Afro American. The Bellwether Co., 1976. pp. 787-804.

This standard reference gives brief biographical data on black scientists and inventors.

C. How Do You Find Out If Science Is a Career for You?

Activity C-1: CONSIDER THE DIFFERENT PLACES PEOPLE WORK AND THINGS THEY DO IN SCIENCE

Materials	Purpose
Activity C-1 Transparency	To demonstrate the relationship between work location and career choice.

Discussion

It is a common misconception that all scientists wear white coats and work in laboratories. This activity has been designed to dispel that notion. People in science work all over the world. They observe the natural world and make hypotheses about how it works. Some people in science careers work in "the field" to collect data. For example, an anthropologist might go to a foreign country to study a specific group or tribe of people, a person studying nutrition might go where people are starving, or a geologist might go where there might be oil. Some or all of these people may share their work by also teaching in a university. People in science careers might appear to be very different from one another, but they are united by their desire to find an explanation for the way things are in the world.

You may find some of the values clarification techniques used in Activities A-2 to A-5 helpful in this activity. Encourage the students to think of where they might like to work and what they might like to do.

Activity

Show the transparency. **Look carefully at these pictures.**

Which picture shows a person working in a science career? Chances are that the students will suggest that the person looking through a microscope is working in a science career. Maybe they will suggest that some of the others are working in science. As you discuss these pictures it will become clear that all these people are working at tasks related to a science career.

All of these pictures show persons working in science careers. Let's look at each one of them closely. Let's start with the one in the middle. Point to picture #1.

What is this person doing? Looking through a microscope.

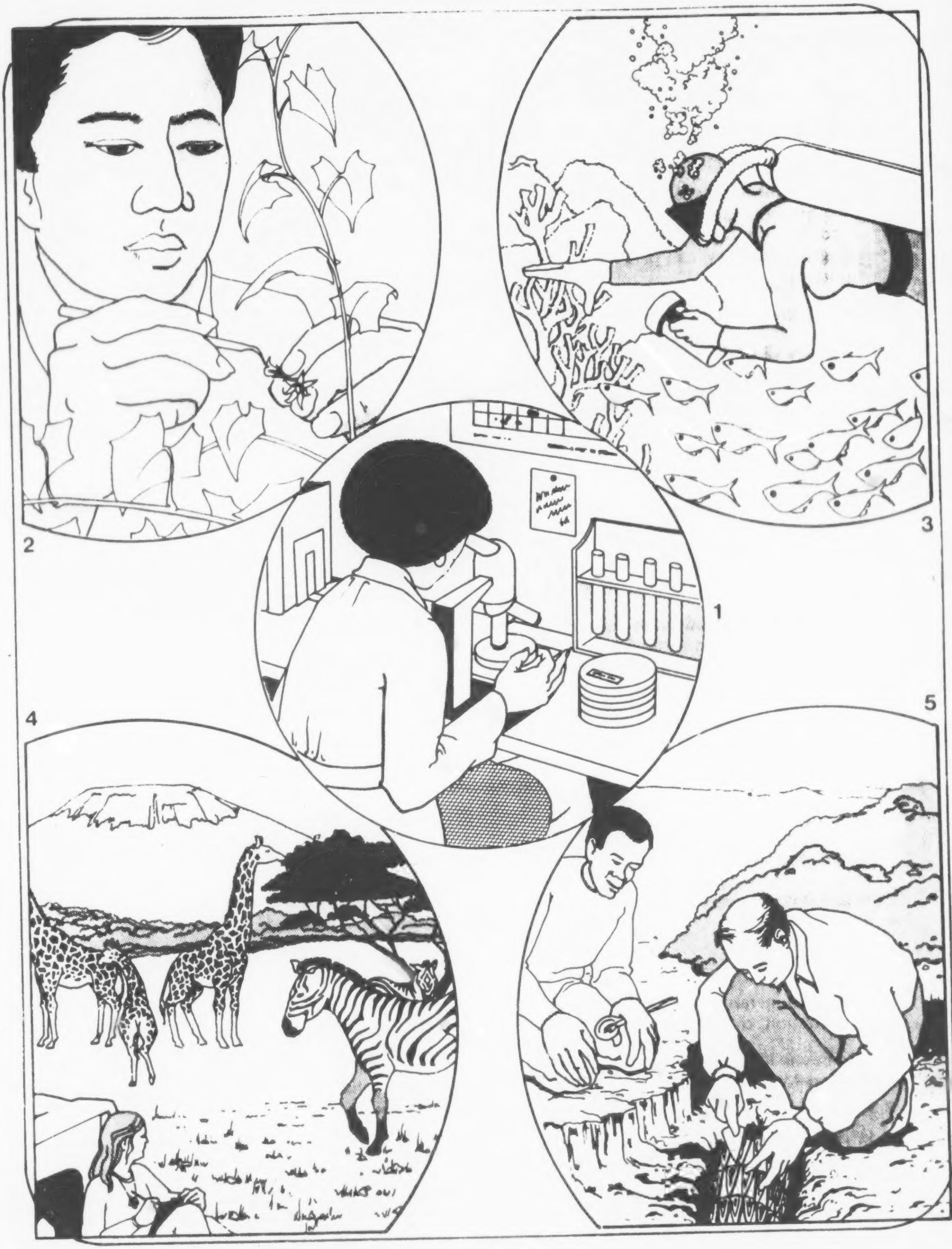
What might this person be studying? A microscope reveals a great deal about the world that the unaided eye cannot see. This person could be studying a great many things, depending on her area of interest. A microbiologist could study micro-organisms; a limnologist could study some (samples of) water taken from a pond; a pathologist could study disease by studying blood and other tissues; a botanist could study the cellular structure of leaves, etc.

Now, let's look at picture #2. What does this picture show? A man investigating (observing) the flower or fruit of a plant.

What might this person be interested in finding out? How the plant grows, how the fruit develops, etc. A geneticist might be interested in fertilizing the plant in special ways to produce new (hybrid) fruit.

Let's look at picture #3. What does this picture show? A scuba diver collecting coral.

What might this person be interested in finding out? How coral grows, where coral grows, in what water temperature coral grows, etc. Perhaps this scientist is an oceanographer. Jacques Cousteau has made oceanography a popular subject with his television series about the scientific investigations he undertakes around the world.



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Now, let's look at picture #4. What does this picture show? A person studying animals in Africa. She could be an anthropologist. Jane van Lawick-Goodall studied chimpanzees in Africa over a long, initial, ten-year period. One of the important discoveries that she made is that chimpanzees use tools. She is an anthropologist.

Now, let's look at picture #5. What does this picture show? Two people uncovering something they have found buried in the ground.

What might these people be interested in finding out? How former peoples (civilizations) lived. Archeologists study the things left behind by former civilizations. From these things, they reconstruct how people lived. Archeologists have made dramatic discoveries such as the tomb of King Tut in an Egyptian pyramid and the remains of Mayan and Incan cities in Central and South America.

Are all these people in science careers working in the same place? No.

Are they all working in laboratories? No.

Why do you think people in science careers work in different places? Scientists need to go out into "the field" to find answers to questions. Some scientists decide where they want to work and then ask questions that relate to that place.

Optional Activity

Note: This activity has been designed for students with above average language ability.

Purpose: To give students an opportunity to explore the relationship between scientific interest and place of work.

In this activity we will be brainstorming. Does anyone know what it is to brainstorm? Discuss brainstorming and in particular the three main rules of brainstorming: 1. Any idea is acceptable; 2. Quantity of ideas is just as important as quality; 3. Evaluation of ideas comes after the brainstorming session.

I will ask you four questions. Try to think of as many answers as you can. All answers are acceptable.

If someone wants to study about fish, where could this person go? Write the answers on the blackboard as the students suggest them. Answers will vary, but might include some of the following: ocean, stream, lake, pond, coral reef, natural history museum, university, Marineland-type parks.

If someone wants to study birds, where could this person go? Write the answers on the blackboard as the students suggest them. Answers will vary, but might include some of the following: beach, mountains, deserts, forests, meadows, migration routes, nesting sites, universities, wild life refuge, zoo.

If someone likes to be on a farm, how many different things could this person study on a farm? Write down the answers on the blackboard as the students suggest them. Answers might include some of the following: farming methods, irrigation, animals, egg production, grains, fertilizers, wind power, hybridization, crops.

If someone likes to be at the seashore, how many different things could this person study at the seashore? Write the answers down. Answers will vary, but might include some of the following: shore birds, tides, erosion, mollusks, dunes, vegetation, waves, surf.

What generalizations can you make from your brainstorming about where science takes place? Science can be done in many places. If someone wants to study a certain thing, there may be many places where that study could take place. If someone wants to work in a certain place, they could have a science career and work there.

Notes and Comments

This lesson has focused on the different places people can work in science. Gerald Michael McCarthy preferred to do his science while roaming the hills of North and South Carolina. There he collected plants, many of which became part of the permanent collection of the Smithsonian Institute. Some of the plants were so rare that they had never been classified.

In 1881, McCarthy was working at Shaw's Botanical Gardens in St. Louis, Missouri, when he decided to make botany his career. He entered a five-year course at Gallaudet College to prepare himself for this career.

Upon graduation, he became one of the first research scientists at the United States Department of Agriculture's Experiment Station at the University of North Carolina. McCarthy was a recognized entomologist (expert on bugs) as well as a botanist (a plant scientist). He was one of the first deaf persons to receive the degree of Doctor of Science.

Teacher Reference

Bolles, Richard Nelson. What Color Is Your Parachute?: A practical manual for job-hunters and career changers. Berkeley, California: Ten Speed Press, 1972.

This book offers valuable information about finding a job, including chapters on rejections, self-esteem, getting help, deciding what you want to do and where to do it, and finding the person to hire you. It cites many additional sources of information.

Harold Munson
College of Education
University of Rochester
Rochester, NY 14627

Forty career briefs developed as part of the Cooperative Research Endeavors in the Education of the Deaf (CREED) projects are available for $40. Of particular interest are:

Career Brief No. 10: Physicist
Career Brief No. 19: Dietitian
Career Brief No. 27: Geographer
Career Brief No. 28: Geologist
Career Brief No. 34: Medical Laboratory Worker
Career Brief No. 35: Medical Record Librarian
Career Brief No. 38: Oceanographer

Activity C-2: THINK ABOUT WHAT TRAINING/EDUCATION YOU WOULD NEED

Materials	Purpose
None	To provide information regarding the training/education needed to pursue a career in science.

Discussion

Every day, science becomes more specialized and technical. It is not hard to see why the need to educate people for science careers is critical. Each new advance creates not only new technology, but also new possibilities of investigations and discoveries. For example, the ability to launch rockets into space has not only thrust us into the space age, but it has also opened up new ways of working here on earth. Communications now routinely rely on satellites. Mapmakers rely on photographs taken from space. Weather predictions are more accurate because of information gathered by weather satellites. So, the education required for a career in science is never-ending if a scientist is to keep up in his or her field. However, the amount of formal education required for any one science career varies according to that career.

Your students should be aware of educational requirements which they would need to meet to achieve science career goals. Some people in science receive on-the-job training. These people might be lab technicians performing routine tests or they might be field assistants. Other science careers require long formal training which leads to a Doctor of Philosophy (Ph.D.) degree. Between on-the-job training and a Ph.D. there are many other options for training for a science career. After high school, students might take a two-year college course leading to an associate degree, or they might take a four-year course to receive a Baccalaureate degree.

Your students might be interested in knowing about Jane van Lawick-Goodall, for she is an unusual example of a scientist who received on-the-job training. She had always had a strong desire to go to Africa to study animals. When the chance came to visit a friend in Africa, she went. There she met Dr. Louis Leakey, a renowned paleontologist. Dr. Leakey encouraged this young British woman to stay in Africa to study a troop of wild chimpanzees. Jane had never been formally trained in science. In fact, she had only a high school education. But she began studying the chimpanzees in 1960. She kept a journal about everything the chimpanzees did. After ten years of work, she published her findings and became the world's authority on chimpanzees in the wild. Then, without an undergraduate degree, she earned her Ph.D. at Cambridge University. Her education did not follow a normal sequence, but her story illustrates that science is not necessarily a function of the amount of formal education which a person has. The ability to succeed in a science career comes with interest and devotion to what one is studying.

This activity will not tell your students exactly what formal training they will need as that is a personal choice, but it should make them aware of the varying kinds and amounts of training available and the requirements of various science careers.

Activity

Note: A classroom teacher may want to invite the guidance counselor into the classroom to lead this discussion.

Write HIGH SCHOOL or MIDDLE SCHOOL or JUNIOR HIGH SCHOOL on the blackboard, whichever is applicable to your students.

This is where you are in your education now. Point to the words on the board. **What can you do in science here?** Your students should answer by discussing what science courses are available to them.

If someone is interested in a career in science, which courses should that person take? Answers depend on how varied a science program is offered in the school. If there is only one science course offered each year, it would be wise for students to take that course. However, if there are enough science courses available for choice, students should be guided in deciding which courses to take.

Do you know anyone who studies some of the science courses offered in the school? Answers will vary.

What do you think some of the courses are like? Answers will vary. Find out if students perceive the courses to be easy, difficult, interesting, and/or fun. See if your students are aware of the "hands-on" approach and laboratory experimentation. Avoid discussion of individual teachers.

Do you have any questions about the science courses offered here? Questions will vary. Bring out in the discussion the idea that courses can be building blocks, one course building on another. Also emphasize the importance of related courses such as mathematics.

Do the courses offered here meet your needs? Answers will vary. This might be a topic for further discussion if the courses do not meet the students' needs.

What other opportunities do you have here in school to develop your interest in science? Answers will vary. If your students are not aware of the Science Fairs which are sponsored by the Science Clubs of America, use this opportunity to discuss them. Perhaps some students might be interested in doing a science fair project. Westinghouse Corporation, through Science Service, supports a Science Talent Search to honor students of science and engineering who have done outstanding work in their fields (see Teacher Reference).

Where have your friends gone for training after they left high school? Answers will vary. In some cases, students will not know where their friends have gone. If you have time, you might like to invite recent graduates back to discuss their lives after high school.

If a person is interested in a career in science, where would that person go after graduation? Answers will vary. There are many ways to prepare for a career in science.

Write the following alternatives (shown in capital letters) on the blackboard.

ON-THE-JOB TRAINING - (certificate)
TECHNICAL INSTITUTES/COURSES/PROGRAMS - (diploma, certificate)
VOCATIONAL SCHOOLS - (diploma, certificate)
JUNIOR AND COMMUNITY COLLEGES - (associate degree, certificate)
COLLEGE - (Baccalaureate degree, certificate)
GRADUATE STUDIES - (masters degree, one-two years; Ph.D. degree, three years of course work plus a dissertation)

Let's discuss each of these alternatives.

Let's start with on-the-job training. Who do you think gets on-the-job training? Many companies offer training for specific jobs to give employees specific technical skills which are usually routine in nature. Such jobs might include doing routine laboratory tests, working with electronics components, learning a computer language, etc. **What are the advantages of on-the-job training?** The employee is receiving a salary; gets close supervision; becomes eligible for better pay; and the job is clearly defined.

What about technical institutes/courses/programs? What are they and who takes them? There are many technical courses available which range from keypunch operating to drafting. Practical and laboratory work are usually the focus. Check the yellow pages of your metropolitan area telephone directory for the range of institutes available. Most often students take technical courses to prepare themselves for a specialized career. The curriculum usually takes about a year to complete. The intensive training students receive qualifies them for entry level technician jobs upon graduation.

What about vocational schools? Vocational schools offer technical training to persons with or without a high-school degree. Courses are generally geared to locally available work. A person might go to a vocational school to learn a specific trade or skill. Usually vocational training takes several years. Vocational schools train automotive technicians, electrical technicians, mechanical technicians, etc. High school level and adult education courses are also offered.

What about college training? College training usually provides a broader background for a career than does on-the-job training or technical school. Junior colleges offer a two-year program, as do many community colleges. Programs leading to a bachelors degree are usually four years.

Although students major in certain areas such as chemistry or biology, many courses outside the major are usually required. College educated students will receive a more varied training than students in any of the options mentioned earlier.

What about graduate studies? Graduate courses can be taken as the name implies, after graduation. This usually means after a person has received a bachelors degree. Graduate courses lead to masters degrees, certification in many fields, and/or Doctor of Philosophy (Ph.D.) degrees. The Ph.D. degree often leads to university teaching.

Who do you think would choose to go to graduate school? Students who are academically able and do well in school may wish to pursue this option.

How do you think you could find out about the training you will need to reach your career goal? Answers will vary but they might include some of the following: Ask your guidance counselor; write to individuals presently working in that career; write to colleges, etc. If you have time, provide copies of A Guide to College/Career Programs for Deaf Students (see Teacher Reference).

Optional Activity

Purpose: To reinforce the vocabulary used when describing training/education.

Your students might enjoy doing a puzzle. This could be done with the whole class or perhaps with only a few students who are not involved with another activity.

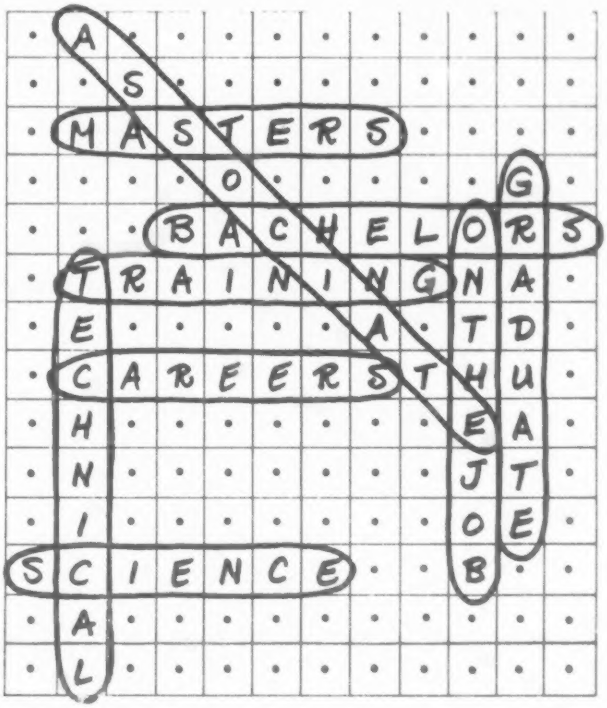
Make copies of the puzzle shown on page 77. Distribute them to your students.

Put the following list of words related to training/education on the blackboard.

ASSOCIATE MASTERS ON THE JOB CAREERS SCIENCE
BACCALAUREATE (BACHELORS) GRADUATE TRAINING TECHNICAL

Tell your students that the words on the board can be found in the puzzle by looking from left to right and from top to bottom. One word can be found on a diagonal from top to bottom. Students should circle the words as they find them.

The answer key below is provided in case some words cannot be found.



·	A	·	·	·	·	·	·	·	·	·	·
·	·	S	·	·	·	·	·	·	·	·	·
·	M	A	S	T	E	R	S	·	·	·	·
·	·	·	·	O	·	·	·	·	·	G	·
·	·	·	B	A	C	H	E	L	O	R	S
·	T	R	A	I	N	I	N	G	N	A	·
·	E	·	·	·	·	·	A	·	T	D	·
·	C	A	R	E	E	R	S	T	H	U	·
·	H	·	·	·	·	·	·	·	E	A	·
·	N	·	·	·	·	·	·	·	J	T	·
·	I	·	·	·	·	·	·	·	O	E	·
S	C	I	E	N	C	E	·	·	B	·	·
·	A	·	·	·	·	·	·	·	·	·	·
·	L	·	·	·	·	·	·	·	·	·	·

Science Training/Education Word Search

•	A	•	•	•	•	•	•	•	•	•	•
•	•	S	•	•	•	•	•	•	•	•	•
•	M	A	S	T	E	R	S	•	•	•	•
•	•	•	•	O	•	•	•	•	•	G	•
•	•	•	B	A	C	H	E	L	O	R	S
•	T	R	A	I	N	I	N	G	N	A	•
•	E	•	•	•	•	•	A	•	T	D	•
•	C	A	R	E	E	R	S	T	H	U	•
•	H	•	•	•	•	•	•	•	E	A	•
•	N	•	•	•	•	•	•	•	J	T	•
•	I	•	•	•	•	•	•	•	O	E	•
S	C	I	E	N	C	E	•	•	B	•	•
•	A	•	•	•	•	•	•	•	•	•	•
•	L	•	•	•	•	•	•	•	•	•	•

Directions: *Look for these words.*

ASSOCIATE
BACHELORS
MASTERS
GRADUATE
ON THE JOB

TRAINING
CAREERS
TECHNICAL
SCIENCE

Notes and Comments

The following example of training/education received for a career in science might interest your students because it shows how important continuing education is.

Edwin J. Parks graduated from Gallaudet College in 1957. As a chemist, he is employed by the National Bureau of Standards. Since graduation he has not stopped studying. He earned 24 graduate credits from the National Bureau of Standards graduate school (an advanced kind of on-the-job training). He earned his MS degree from American University in 1971 and is now pursuing his Ph.D. in chemistry from the same university. As a research chemist, he runs an experimental laboratory and received an Outstanding Performance rating from the NBS for his achievements in developing thermal methods of analyzing modified cellulose. Parks has been able to continue his education in conjunction with a full-time career.

Teacher Reference

National Technical Institute for the Deaf
Office of Public Information
One Lomb Memorial Drive
Rochester, NY 14623

Send for a free copy of A Guide to College/Career Programs for Deaf Students, revised 1975. This guide is a valuable reference source for students to help in selecting a program after high school. It describes programs for the deaf at Gallaudet College and the National Technical Institute for the Deaf (NTID) as well as programs in 23 states, the District of Columbia, and Canada. Each description includes the name of the program director, the name and address of the person to contact for more information, when the program was established, major emphasis, number of full-time students, annual cost, type of institution, accreditations, number of degrees awarded to deaf students, number of degrees awarded to deaf students in 1975, preparatory activities, availability of special services for the deaf, and the major areas of study of deaf students during the 1974-75 academic year.

Science Service
1719 N Street, N.W.
Washington, DC 20036

Information about Science Youth Programs which include Science Clubs of America, Science Talent Search, International Science and Engineering Fair and THINGS of Science can be obtained from Science Service.

Suggested Student Reading

Millard, Reed. Careers in Environmental Protection. New York: Julian Messner, 1974.

This book describes careers in conservation and the training needed for these careers.

van Lawick-Goodall, Jane. In the Shadow of Man. New York: Dell Publishing Company, Inc., 1971.

This book describes Jane van Lawick-Goodall's work with chimpanzees in the wild.

BEST COPY AVAILABLE

C. How Do You Find Out If Science Is a Career for You?

Activity C-3: INVITE A GUEST SPEAKER

Materials

None for the student. The speaker may require a slide projector, blackboard, overhead projector, podium, interpreter, etc.

Purpose

To give students an opportunity to meet a person working in a science career.

Discussion

One of the ways to make science careers vivid to your students is to invite a person working in a science career to your class. This will have a special impact if the person is also deaf because it will give your students an opportunity to relate to a deaf role model who works in science.

Whom you invite depends a great deal on the kinds of science careers in your locality and the needs and interests of your students. You should consider the resources of your community and try to match them with the needs of your students. The American Association for the Advancement of Science (AAAS) has published a list of handicapped scientists, some of whom are deaf, who might be especially appropriate visitors to your classroom (see Teacher Reference). Other sources of visitors might be local industries or universities.

Although you probably will not be able to invite a Nobel Laureate to visit your class, your students might be interested in learning about British chemist, Sir John Cornforth, who shared the 1975 Nobel Prize in Chemistry with Vladimir Prelog of Zurich, Switzerland. Cornforth has been deaf since he was 20.

Cornforth started losing his hearing when he was 14 years old. His chemistry teacher encouraged him to take up chemistry as a career. By the time he earned his Ph.D. at Oxford, he was totally dependent on the written word and lip reading. Cornforth won the Nobel Prize for his work in stereochemistry. He studied the build-up, breakdown, and architecture of complex biological molecules.

In discussing the language of science, Cornforth explained: "One of the most liberating experiences for me was the realization that there are so many languages—molecular structure, stereochemistry, and mathematics, for example — that have nothing to do with the spoken word. In these nonverbal languages a deaf person isn't handicapped at all."

"Obviously, there are many things that a deaf person can't do, or can do less well than a person with unimpaired hearing," he admits. "On the other hand, if you don't get the stimulus of conversation, you tend to develop your own habits of thought. And there are some things that a deaf person can do better. One is the ability to go for long periods of total concentration."

Cornforth is an intense, intellectual person. He is an excellent tennis player and chess enthusiast. He collects and enjoys writing limericks.

Activity

Before you invite the speaker, decide what you want the speaker to discuss. Besides a description of what the person does in the career, you might like the speaker to discuss how a deaf person might function in the same career or in related careers. Another topic of interest might be the education the person received in order to have the career and the steps taken to gain their current level of employment. Be sure to leave time for student questions.

Several days before the speaker comes, discuss the visit with your students. Include in the discussion facts about the speaker and also about his or her career. Help the students formulate some questions that they would particularly like answered. If you have invited a highly trained scientist, you might also think of inviting a technician with a science career to emphasize the range of career opportunities available in science.

When the speaker has gone, discuss with your students their reactions to the visit. Ask them to indicate "yes," "no," or "no opinion" to the following questions:

Did you learn something that you did not already know?

Do you think you could do what the visitor does?

Do you think you could do something related to the visitor's career?

How did the speaker make you feel about science careers?

Notes and Comments

Robert Menchel is a senior physicist for Xerox Corporation. He has been deaf since the age of seven. During 1978, he spent a year's sabbatical leave with full salary from Xerox working with the American Association for the Advancement of Science, Handicapped in Science Program. He traveled to a dozen states to seek out and speak to handicapped children and their parents about education and careers in science. His goal was to help remove barriers for handicapped youths and adults and to show them that it is up to them to determine what they do with their lives.

Teacher Reference

American Association for the Advancement of Science
1515 Massachusetts Avenue, N.W.
Washington, DC 20005

Available in the fall of 1978, Directory of Handicapped Scientists will be in many libraries. The price has not been determined.

Cornforth, John S. "Asymmetry and Enzyme Action." Science, Vol. 193, pp. 121-125, July 9, 1976.

This is Cornforth's acceptance speech for the Nobel Prize in Chemistry.

Elrel, E. L. and H. S. Mosher, 'The 1975 Nobel Prize for Chemistry." Science, Vol. 190, pp. 772-774, Nov. 21, 1975.

This article has factual information about recipients of the 1975 Nobel Prize in Chemistry and their work.

C. How Do You Find Out If Science Is a Career for You?

Activity C-4: GO OUT AND SEE FOR YOURSELF

Materials	**Purpose**
None required, although brochures describing student tours at local institutes might be helpful An interpreter	To plan and take a field trip to a local science industry or institution.

Discussion

Probably one of the strongest ways of developing career awareness is to take field trips. Nothing can convey what a working situation is like better than actually seeing one. Exposure to actual job situations is important to all students, but this exposure is even more essential for the deaf since these students are usually cut off from informal conversation leading to some understanding of occupational activities and work environment. So, whatever effort is necessary should be made to make this activity a success.

If you have had work experience in a science-related facility, you might want to take your students to a similar site. If you are not familiar with science-related employment sites, you may want to take along a science teacher or someone else who is familiar with the kind of site you will be visiting. If you are unfamiliar with such a site and you must go alone, it is suggested that you tour the facility before you take a student group.

Try to find out where there are deaf people working in science as that place would be of particular interest to your students.

Furthermore, the importance of the guide at the employment site should not be underestimated. Make sure the guide knows the purpose of your visit, i.e., to encourage deaf students to seek employment at such a site in the future. If the proposed guide is not receptive to having deaf employees at that site, your visit will not be a positive experience.

Activity

Have you ever been to a place where people are working in science? Answers will vary. They might include a museum of natural history or technology, industry, a college laboratory, etc. Discuss any places the students have been. Find out what kind of science they saw.

The filmstrip showed several places where people work in science. What were these places? agricultural laboratory, medical laboratory, chemical laboratory, computer center, and weather bureau.

We will be making a field trip to see a place where scientists work. Where do you think you might like to go? Discuss this question carefully with your students. The following questions might be helpful:

If you are interested in medical sciences, where might you go? hospital, pharmaceutical house, etc.

If you are interested in nature and the environment, where might you go? a science museum, a water treatment plant, etc.

If you are interested in chemistry, where might you go? a chemical industrial plant, a dye works, a refinery, etc.

If you are interested in engineering, where might you go? a local engineering firm, a site of a new bridge or highway, etc.

If you are interested in animal research, where might you go? a zoo, a veterinary hospital, zoology department at college or university, etc.

After the class has discussed several options, decide on one. A simple way is to vote, although keep in mind the purpose and context of the trip and that the trip might be an annual event. You also might want to [illegible] committee to make arrangements for the trip.

Before the trip:

- Write or have someone call the place you want to visit to set up an appointment, interview or guided tour. Explain that the students are deaf and that someone will interpret for them.
- Arrange for transportation.
- Work with the school administration so that the schedules of other classes can be changed.
- Encourage students to present themselves as well as possible by dressing well and by having some questions which they would like answered.

After the trip:

- Write a thank-you note.
- Discuss the trip with your students. The following questions might help you get started:

  What were people doing at the place you visited?

  What did you see that surprised you?

  Give an example of someone you saw making observations.

  What special abilities did these people have? Any disabilities?

  Would you like to work in a place like the one we visited?

  Did you see people working alone? Did they communicate? How?
- Provide time for students to explore new interests that have resulted from the field trip.

Optional Activity

Purpose: To give students an opportunity to learn more about the daily activities of a person working in a science career.

Your students might like to visit other places on their own or with a small group of friends. Encourage them to do so. You may need to make the arrangements for the student(s).

As a result of a field trip, a student(s) may become particularly interested in a science career observed on the field trip. You may be able to arrange for the student(s) to return to the field trip site and "shadow" a particular worker there. By "shadowing," a student would follow the worker throughout the course of the day. Obviously, a great deal could be learned about what that worker does on the job. The student(s) could take notes during the visit. Before such an experience, work with the student(s) to develop an awareness of how to act in such a way as not to disturb the worker on the job. There will be appropriate times for questions and the student(s) should think of some in advance of the visit. If possible, an interpreter should be used to help facilitate communication between the deaf student(s) and the worker so that the student(s) can learn as much as possible from this "shadowing" experience.

Teacher Reference

Harold Munson
College of Education
University of Rochester
Rochester, NY 14627

Request Learning About Work *(teacher's manual at $2.00 and student handbook at $1.60) written by Harold Munson, Judy Egelston, and William Howard. The manual and handbook will be helpful in planning the field trip.*

Suggested Student Reading

Munson, Harold, Judy Egelston, and William Howard. Learning About Work: Student Handbook. Rochester, N.Y., 1975.

This handbook will be helpful in planning the field trip (see Teacher Reference).

C. How Do You Find Out If Science Is a Career for You?

Activity C-5: WRITE FOR INFORMATION

Materials

Paper
Pencils
Typewriter or pens
Envelopes
Stamps
Metropolitan telephone directory yellow pages

Purpose

To demonstrate how to write to companies, institutions, or scientists to obtain information about careers in science.

Discussion

Note: This activity may take two periods. If your students have letter writing skills, omit Part 1.

Many companies, institutions and scientists are very pleased to answer questions and provide information to interested students. A well written letter often yields a great deal of information, both in a personal reply and in published information such as brochures and pamphlets. In this activity, your students will have an opportunity to write letters to places that might have information regarding possible career opportunities for them.

Part 1

Activity

Copy this letter format on the blackboard:

Writer's address
Date

Name
Address

Dear ____,

Body of letter which asks for information

Sincerely,
Signature of writer

Letters are usually hard to write, especially to strangers. What are some reasons people might write letters to strangers? To ask for information, to comment on a product or a service, to transact business, etc.

In this activity, you will be writing to strangers to ask for information about careers in science. But before we get into the serious part of this activity, we will practice by writing a few letters just for fun.

Write the words SPIDER, ROCK, WHALE, and STAR on the blackboard.

Suppose you want some information about these things. To whom could you write to get the information? Answers will vary. They might include a science museum, a geologist, an astronomer, an expert at an aquarium, a professor.

I would like you to write a letter directly to one of the four things I have written on the board. Start your letter, "Dear Spider," or "Dear Rock." Ask for information and also ask how the thing would like a scientist to study it. Ask what training would be needed if a person wanted to study the thing. Use the standard letter form which I have written on the board. These letters may be filled with humor and your students should be eager to share them with the class. If there is time, compose answers to the letters and share them.

Part 2

Now, where might you get real information about your science interests? Answers will vary. You might elicit or suggest some of the following:

- A student interested in rocks and minerals might get information from a local museum.
- A student interested in psychology might contact a psychologist.
- A student interested in astronomy might contact a local observatory or planetarium.
- A student interested in weather might contact the airport weather station.

Brainstorm as many sources of information with your students as possible. Write possible sources on the blackboard. Try to think of a good source of information for each student's personal interests and goals regarding science.

Government agencies are good sources of information. The yellow pages of a telephone directory of a nearby metropolitan area might be very helpful. Think of writing to local colleges and universities to contact scientists. A personal contact can be worth many letters. (See also list of organizations in Teacher Reference, Activity B-1, page 42.)

What kind of information might you ask for in your letters? Answers will vary. They might include asking for some of the following: brochures or pamphlets, career opportunities, information about jobs, job descriptions for professionals in the field, an interview, a visit, etc.

When the letters are written, check the spelling and punctuation. If students do not have a name to address the letter to, suggest that they write a salutation such as "Dear Madam/Sir," "To whom it may concern," "Dear Director of Public Information," or "Dear National Geographic Society," — all of these alternatives instead of "Dear Sir" which makes assumptions about the sex of the receiver of the letter. Ask students to copy over or type a neat copy of the letter. Emphasize the importance of a neat, concise letter which will encourage a prompt, helpful response.

Optional Activity

Purpose: To encourage students to ask for information in person.

The focus of this activity has been on writing for information. If in the course of writing for information students have chosen to write to local businesses or institutions, encourage them to visit the place. Often an "in-person" inquiry will yield the information more efficiently and sometimes more "painlessly" than a formally written request. So, encourage your students to ask questions wherever they are (such as in museums, airports, zoos, etc.) and also to go to places about which they are interested.

Fisk, Margaret, ed. Encyclopedia of Associations, 11th ed. Detroit, Michigan: Gale Research Company, 1977.

This encyclopedia lists all organizations and associations in the United States. Available at most libraries, it is an invaluable source of names and addresses, conveniently indexed by subject.

General Electric Company
Educational Communications Programs
Fairfield, CT 06431

Ask for any one or all of these free booklets: "What's it like to be an engineer?" "Planning Your Career," "So you want to go to work," "What's it like to be a technician," and "What's it like to work in the business world." Each booklet gives concise, detailed and valuable information in a highly readable and richly illustrated fashion. For a comic book treatment about an aspiring engineer, ask for "Quincy Looks into his Future: Careers in Engineering."

National Geographic Society
17th and M Streets, N.W.
Washington, DC 20036

If your students request information about a specific subject, such as oceanography, marine biology, wildlife, etc., the Society will send a list of National Geographic articles on this subject. The Society will also send a publication order list which enumerates the publications containing information on science.

National Wildlife Federation
Educational Servicing Section
1412 16th Street, N.W.
Washington, DC 20036

Students can ask for the brochure "Conservation Careers." (Single copies are free; additional copies are $.15 each; 50 copies or more are $.12 each.) This brochure discusses conservation as a science career, specific jobs in government, industry, and educational and research institutions; education and training required; salary; etc.

Opportunities in Science
American Association for the Advancement of Science
1515 Massachusetts Avenue, N.W.
Washington, DC 20005

This organization will identify a scientist or an organization which may be able to answer specific questions which your students may have. Write if you are unable to locate a source from the Encyclopedia of Associations (see above).

Science Service
1719 N Street, N.W.
Washington, DC 20036

Science Service is devoted to the development of public understanding of science and science youth activities. It publishes the only weekly news magazine, Science News, which summarizes in a highly readable way the latest developments in various science fields. It operates a book order service. THINGS of Science, kits which contain science experiment materials, are mailed monthly to over 30,000 subscribers. Science Service sponsors Science Clubs of America, which foster science activities in schools. The Science Talent Search identifies high school seniors in the United States who are outstanding in science, mathematics and engineering. The International Science and Engineering Fair gives students in ninth through twelfth grades an opportunity to compete for 450 awards as well as to meet and share ideas with others equally interested in science.

Smithsonian Science Information Exchange, Inc.
Room 300
1730 M Street, N.W.
Washington, DC 20036

The Smithsonian Science Information Exchange provides summaries of recent basic and applied research studies.

The Travelers Companies
c/o D.K. Deward, Director of Employment and Training
One Tower Square
Hartford, CT 06115

Ask for the brochure, "Data Processing Careers at The Travelers." This brochure describes careers in data processing at The Travelers.

C. How Do You Find Out If Science Is a Career for You?

Activity C-6: KEEP UP WITH SCIENCE

Materials

Magazines and newspapers that can be cut up
Pencils
Paper
Glue
Looseleaf notebooks or folders

Purpose

To encourage students to keep a journal or scrapbook about things that interest them in science.

Discussion

Science is a vital part of our lives in the twentieth century. It has perhaps been the single most powerful force in shaping our society. And, as many of the activities in this career development package have indicated, the effects of scientific research touch every aspect of our lives. An informed public in a scientific society is critical. If students get into the habit of following scientific developments, they will become part of that informed public. They might also discover a career in science that will provide them with life-long satisfaction.

Many people in science have kept journals or have written about their work or about things that have interested them (see Suggested Student Reading). A journal is a place to write facts and ideas of interest. A journal can be a collection of papers in a looseleaf notebook or folder. A very good way to start a journal is to clip articles and pictures out of magazines and newspapers, paste these clippings on paper, and comment on the paper about each clipping. Gradually, the comments become longer as the thought process develops.

Activity

How much do you think people, not in science careers, know about science? Answers will vary. Some people will know more than others.

How important do you think it is to know what is happening in science and how it affects you? Answers will vary again from "very important" to "not so important."

If you think it is important, or even if you don't, where can you find out about science developments? Science news magazines and journals are excellent sources. Most weekly news magazines have sections devoted to science. Newspapers have daily or weekly coverage of science developments.

Are developments in science big secrets? Some are, especially those dealing with defense, but usually big developments are picked up by the popular press, and everyone can read about what is happening.

Have you ever thought of writing your reactions to what happens around you? When you keep a journal, that is what you do. You think about what has happened, and you write down what you think. How might it help you to keep a journal? Answers will vary, but a major reason might be to sort out ideas about things as you write them down.

If you kept a journal, what topic would you like to include in it? Ideas will vary, but they should reflect topics in which each student is personally interested. So, a student interested in engineering might write about buildings, bridges, roads, etc., and a student interested in space exploration might write about rockets or UFO's.

List three things about science that interest you. For each thing you list, write a brief sentence telling why you are interested in it. I will give you a few minutes to do this now. If students have difficulty expressing reasons, accept their interests without reasons. Provide the chart on the following page as an aid, if necessary.

I AM INTERESTED IN...	BECAUSE...
1.	
2.	
3.	

As students finish this task, check over their work.

When you have finished writing your sentences, you may look through these magazines and newspapers. Clip any article that is about science which interests you, paste it onto a piece of paper and tell why you like it. After you write your ideas on paper, put them into a folder or a looseleaf notebook, and you will be on your way to having a journal.

Notes and Comments

The following notes show how two deaf people pursued their interests in science although it was not their career. Farrar kept records about his excursions and Lowe's journal was critical in deepening his interest in language.

Abraham Farrar was the first deaf person to pass the rigorous entrance exams for Cambridge University with honors. He became a prodigious scholar, geologist, and collector of old books. He probably attained greatest fame as a champion of deaf education. However, his interest in geology was so strong that he took several excursions to study extinct volcanoes and other geological formations.

John William Lowe was born deaf, but showed academic promise as a young man, and his father encouraged him to enter the law. Lowe practiced law for 51 years from 1820-1871. Nevertheless, Lowe devoted a half-hour each day to the study of some language. By the time he was in his thirties, he could read French, Latin, Greek, German, Italian, Spanish, Portuguese, Dutch, and Danish. His note-taking or journal-writing about language helped him to develop his knowledge and insights.

Suggested Student Reading

Carson, Rachel. The Sense of Wonder. New York: Harper & Row, Publishers, 1956.

Many beautiful photographs enhance the text which discusses the wonders of nature.

Darwin, Charles Robert. The Voyage of the Beagle. New York: Harper, 1959.

Darwin's historic journey during which he developed the theory of evolution is vividly recounted.

Eiseley, Loren. The Unexpected Universe. New York: Harcourt, Brace & World, 1969.

Eiseley's mother was deaf. Eiseley became a world renowned anthropologist. He wrote as a humanist about his impressions, reactions, and understandings of the world about him.

Lorenz, Konrad Z. King Solomon's Ring. New York: Thomas Y. Crowell & Co., 1952.

Lorenz's purpose is "to convey to (his) readers at least an inkling of the infinite beauty of our fellow creatures and their life." Lorenz writes as a naturalist.

Watson, James D. The Double Helix. New York: Atheneum Publishers, 1968.

In this exciting book Watson describes the highly competitive race to discover the structure of DNA (deoxyribonucleic acid). Working with Francis H. S. Crick, he discovered it to be a double helix, a structure similar to two spiralling staircases turning around each other.

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